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USSR Report

SCIENCE AND TECHNOLOGY POLICY

SPECIAL NOTICE INSIDE

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SPECIAL NOTICE

Effective 1 June 1987 JPRS reports will have a new cover design and color, and some reports will have a different title and format. Some of the color changes may be implemented earlier if existing supplies of stock are depleted.

The new cover colors will be as follows:

CHINA....................aqua
EAST EUROPE..............gold
SOVIET UNION.............salmon
EAST ASIA................yellow
NEAR EAST & SOUTH ASIA...blue
LATIN AMERICA............pink
WEST EUROPE..............ivory
AFRICA (SUB-SAHARA)......tan
SCIENCE & TECHNOLOGY.....gray
WORLDWIDES...............pewter

The changes that are of interest to readers of this report are as follows:

USSR reports will become SOVIET UNION reports.

The USSR REPORT: NATIONAL ECONOMY will be titled SOVIET UNION/ECONOMIC AFFAIRS (UEA).

The USSR REPORT: POLITICAL AND SOCIOLOGICAL AFFAIRS will be titled SOVIET UNION/POLITICAL AFFAIRS (UPA).

The following Soviet journals will be added to those which are already issued in separate series:

EKO: ECONOMICS & ORGANIZATION OF INDUSTRIAL PRODUCTION (UEO)
THE WORKING CLASS & THE CONTEMPORARY WORLD (UWC)
PEOPLES OF ASIA & AFRICA (UAA)
MILITARY HISTORY JOURNAL (UMJ)
FOREIGN MILITARY REVIEW (UFM)
AVIATION & COSMONAUTICS (UAC)
SOCIOLOGICAL STUDIES (USS)

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22 MAY 1987

USSR REPORT

Science and Technology Policy

Contents

GENERAL

ORGANIZATION, PLANNING AND COORDINATION

SUMMARY OF REPORTS AT LATVIAN ACADEMY GENERAL ASSEMBLY

Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR in Russian No 5, May 86 pp 24-33

[Article by Ya. Kristapson under the rubric "The Annual Session of the General Assembly of the Latvian SSR Academy of Sciences": "The Discussion of the Reports"]

[Text] Vice President of the Latvian SSR Academy of Sciences Academician A.A. Drizul spoke first during the discussion.

"We all sensed the revolutionary spirit of the Policy Report of the CPSU Central Committee, which M.S. Gorbachev delivered," Academician A.A. Drizul said, "while following with enormous attention the work of the 27th party congress. The report makes a strong impression by not only the depth of the theoretical elaboration, which provides a stimulus for the scientific research of social scientists, by not only the poignancy of the statement of the problems, but also by the tone, by the honest, courageous voice of the truth. While following the work of the congress, we all thought that, if during all the past years we had not spoken so much about our successes and achievements, we would not have to discuss today the miscalculations and imperfections, the blunders and shortcomings in various spheres of socioeconomic life, including in science. In the Policy Report of the CPSU Central Committee it is stated: 'The question of increasing openness is one of principle for us. This is a political question.'

"In the postwar period two party congresses," Academician A.A. Drizul said, "hold special, permanent importance in the history of our state and the entire world. These are the 20th CPSU Congress in February 1956, which condemned the personality cult of Stalin, and the 27th CPSU Congress, which was held now, at a sharp turning point in the life of the country and the modern world as a whole."

"The 27th CPSU Congress showed that the party is most capable of learning lessons from the past, of interpreting in a broad, Leninist manner the times being lived through, and of elaborating a realistic, thoroughly weighed program of actions.

"In resoluteness and straightforwardness, openness and honesty, in the Bolshevik truth, in all this we sense the pulse of Lenin's thought. It is

impossible not to share with all the delegates and participants in the 27th CPSU Congress the words concerning the fact that the April (1985) CPSU Central Committee Plenum, the preparation for the congress, and all its work proceeded 'as if in accordance with Lenin's synopses.'

"In the Policy Report of the CPSU Central Committee it is stated plainly: the slowing of socioeconomic development was a consequence of serious blunders in the area of not only economic management, but also ideological work. Ideological work, thus, our work, the work which concerns us, social scientists, for the party regards the social sciences as the most important means of educating a person. It is necessary to scrutinize our everyday work from this standpoint, which is demanding and strict. It is necessary for everyone, beginning with himself, to evaluate his scientific contribution to the accomplishment of the tasks which were posed by the 27th CPSU Congress.

"The enormous role of criticism and self-criticism in our progress was repeatedly emphasized at the congress. For the man of science a critical approach is both a professional and a moral norm. Without polemics in science there is no further increase of new knowledge, that is, there is no science itself. However, it must be said that in recent years on the pages of scientific journals, including our academic journals, you will rarely encounter scientifically sound polemics and the raising of new questions and problems. Favorable, at times empty, and often also publicity reviews have taken their place.

"All the Soviet people, including us, the workers of science, have to accomplish immense, painstaking work on changing our consciousness. By its very psychological nature scientific creativity is akin to artistic creativity. Both a certain vulnerability and ambition are characteristic of both the artist and the scientist. Healthy ambition, which is due to the desire to promote by one's own efforts the success of the common cause, yields deserved success. But when self-esteem, pretentiousness, and egoism gain the upper hand, envy and ridiculous vanities can not only undermine, but also ruin the cause itself, as well as the creative collective itself.

"The materials of the congress give the workers of science a clear and correct guide in the campaign against this moral evil. The decisions of the congress and the instructions of the party caution us against distortions and work in spurts in everything, including science. The proposition of the Policy Report of the CPSU Central Committee concerning the need for more attention to the basic sciences and to the broadening of the scale of research and not only to be concerned about today and yesterday, but also to think about the future received the full support of the congress. The Policy Report of the CPSU Central Committee requires us not to forget about the new scientific generation and about the attraction of talented people to science.

"The promotion of talented young scientists is especially urgent, since it has to be stated that the average age of doctors and candidates of sciences in our country is increasing from year to year. In 1980 at the Latvian SSR Academy of Sciences there were 104 doctors and 810 candidates of sciences with an average age of 54, while in 1985 there were 116 doctors and 954 candidates of sciences with an average age of already nearly 57. In 1985 the average age of

academicians was 65, while that of corresponding members was 59. The average age of scientific associates, who had defended doctoral dissertations, also increased: in 1981 it was 44, while in 1984 it was already more than 52.

"In January-February of this year the staff of the Komsomol Searchlight of the Latvian SSR Academy of Sciences conducted a sociological study for the purpose of determining the dynamics of the creative activity of young scientists and their evaluation of the organization of their own scientific work and the prospects of scientific advancement. The survey encompassed 586 young scientists. Of them 420 (70 percent) are directly involved with scientific research.

"What is the average statistical young scientist of the Latvian SSR Academy of Sciences?

"This is a person with a higher education up to 33 years old with an average wage of 152 rubles. They make up 24 percent of the number of associates with a higher education at the academy. The average statistical young scientist has on the average 3.5 published articles, 2.5 statements at conferences, and 0.33 invention.

"A more thorough analysis reveals a number of negative trends which hinder the scientific advancement of young personnel. In all 50 percent need an improvement of housing conditions, 21 percent are waiting in line to receive living space, of them about a third have been waiting in line from 5 to 10 years. Spaces in preschool children's institutions are needed by 18 percent. For the majority of young specialists the wage actually comes to 130-140 rubles; the exception is scientific production institutions--the Center of Robotics of the Institute of Physics; the Institute of Polymer Mechanics; the Special Design Bureau of Magnetohydrodynamics. At the Institute of Electronics and Computer Technology the wage ranges from 140 to 305 rubles. For young specialists the increase of the wage during the first 9 years of work comes to 5-10 rubles at 6 institutions, 10-20 rubles at another 6 institutions, and 20-30 rubles at 4 institutions. Only at the Institute of Electronics and Computer Technology does this increase come to 30-40 rubles. The young scientists of the institutes of physics, organic synthesis, history, biology, and microbiology have the largest number of publications and statements at conferences. The results are low at the Physics and Power Engineering Institute, the Institute of Philosophy and Law, and the Institute of Electronics and Computer Technology, while the young people at them make up respectively 25 percent, 39 percent, and 30 percent.

"We have very few candidates of sciences among young scientists (6 percent), only 32 percent complete graduate studies with the submitting of a dissertation, and very few developments of young scientists are performed at the level of inventions. A fifth of the young associates, who are engaged in research work, believe that they do not have scientific supervisors.

"Among the other factors, which divert young scientists from scientific work, the most urgent are the problems of material and technical supply and the shortage, and at times also the lack, of technical personnel. It is possible to a certain degree to explain the low creative output of young scientists by

the low level of their wage and its negligible increase with the increase of the length of service. The aspiration of young scientists to increase their scientific skills, to study in graduate courses, and to consolidate scientific results with the defense of a dissertation appears most strongly during the first 5-7 years of work. However, precisely during these years most often young families are formed and the need for one's own housing and for the placement of children in preschools institutions arises.

"The solution lies in one thing--for the stimulation of young scientific personnel it is necessary to use extensively the new conditions of the remuneration of labor and to settle promptly the question of the construction for their needs of a children's preschool institution and an apartment house for young specialists, as well as to support the initiative of Komsomol members on the establishment of a young people's housing complex.

"The small stipends of full-time graduate students, which have been retained so far, are hindering the influx of young talented personnel into science. Not by chance are only 47 of the 156 graduate students studying in full-time graduate courses, of them 41 graduate students receive stipends of 100 rubles, while already having a length of service of more than 2 years, while 6 graduate students receive stipends of 85 rubles. The opportunities of a graduate student to earn a little extra are very limited--only through the fulfillment of economic contractual work and, in addition, this hinders the fulfillment of the curriculum. Of the 47 full-time graduate students 14 are additionally working on economic contracts for half pay with salaries of 56 to 80 rubles. Obviously, the question of increasing the graduate student stipend if only to the amount of the average salary of a scientist in accordance with the new system of the remuneration of labor became urgent long ago. And it is necessary to settle it throughout the country, for this is not within the competence of republic authorities.

"At the 27th party congress in the Policy Report of the CPSU Central Committee and in the statements of delegates a great deal was said about what is preventing us from living and from working normally. The alarming tendency for bureaucracy to increase, which occurred over a number of years, was spoken about. Bureaucracy has many faces and paper bureaucracy and the flow of unnecessary documents are grouped with one variety of it. Not by chance does V. Dal in his dictionary interpret bureaucracy as 'multiple authority and much writing.' The paper flow is also swamping our Academy of Sciences.

"One cannot do with business correspondence, monitoring, and accounting. But it is quite obvious that the paper 'gross' has significantly surpassed the reasonable needs and it is necessary to put an end to this 'gross.' Otherwise we will be left without paper for the publication of scientific works. For example, the number of copies of the book 'Istoriya Latviyskoy SSR s drevneyshikh vremen do nashikh dney' [The History of the Latvian SSR From the Most Ancient Times to Our Day], which has not been published in nearly 20 years, was set at only 15,000. A third of the entire number of copies was sold in a few days, but the public at large needs this book, and not for 1 year.

"Today everyone should work with even greater efficiency in order to make his contribution to the common cause of accelerating the development of the entire country. This is leading to the reorganization of our work at each scientific institution and to the change of the criteria of work and the style of the making and fulfillment of decisions. At the base of everything is the change of man, the human factor. Here everyone is for this, but everyone must begin with himself. It is necessary to accept the criticism meant for oneself without any skepticism and emotions, while at the same time deepening the approach to work, without retreating in the face of risk, and keeping one's responsibility in mind. It is necessary to live by checking one's deeds and actions against the requirements of the new tasks. It is necessary to be guided by Lenin's lessons of truth and the bequest of Lenin to all of us: 'Do not be afraid to recognize our own mistakes, do not be afraid of the repeated, repetitive labor of their correction, and we will be at the very top.'"

Latvian SSR Minister V.-E.G. Bresis, first deputy chairman of the Latvian SSR State Agroindustrial Committee, devoted his statement to the questions of the further development of agrarian science in the republic.

The 27th CPSU Congress posed specific tasks for sectorial agrarian science. First of all we should concentrate our efforts on achieving the intensification of sectorial agrarian science itself. Without the intensification of science the intensification of the agroindustrial complex cannot be achieved. Unfortunately, with respect to several questions practice today is ahead of sectorial science.

The second direction of our activity is the changeover of our sectorial science from agrarian science to the science of the agroindustrial complex. This is a very difficult question, which involves the reorientation of the activity of our institutes. Our design bureaus and the laboratories of the former ministries and departments of the agroindustrial complex of the republic can play a significantly greater role in this.

The third direction of our activity is the integration of science and production. We are making the community of interests of scientific institutions and production the basis for this integration. On the basis of this principle two scientific production associations have been established in the agroindustrial complex of the republic: the Agro--on the basis of the Scientific Research Institute of Farming and Agricultural Economics, and the Sigra--on the basis of the Scientific Research Institute of Animal Husbandry and Veterinary Science. At present we are considering the question of establishing a scientific production association on the basis of the Scientific Research Institute of the Electrification and Mechanization of Agriculture and our plants for the production of agricultural machinery. The Scientific Center of the republic State Agroindustrial Committee, which consists of the named institutes, as well as the administration of scientific and technical information, the laboratory of the scientific organization of labor, the laboratory of standardization and metrology, and others, has been established. Apparently, much work on the further coordination of all scientific research precisely within the republic State Agroindustrial Committee itself lies ahead.

Another direction of our activity is the integration of science itself within the agroindustrial complex. We are not destroying the legal independence of institutes, but should integrate scientific thought itself. We are establishing combined scientific groups for the study of the principal questions of the development of the agroindustrial complex. Scientists of different institutes are being included in these groups. I want to request the participation and assistance of scientists and institutes of the Academy of Sciences and active work within these groups.

We regard the contact with the Academy of Sciences as exceptionally important for our further development. Traditional relations have been established here with the Institute of Microbiology, where under the supervision of Academician M.Ya. Beker a number of most important studies are being conducted. Cooperation with the Institute of Wood Chemistry is forming well. I would also like the express the wish, for example, for cooperation with the Institute of Biology in selection, first of all, of grain crops. In a number of countries due to the introduction of new strains into crop rotation they are obtaining a 40-percent increase of the yield. Unfortunately, we are still not achieving such high results, since our strains do not yet satisfy the requirements of today.

The institutes of the republic State Agroindustrial Committee should receive assistance from the Academy of Sciences in the cellular engineering of plants, the use of mathematical methods of selection, and others. We also await new developments from the Institute of Organic Synthesis. Many effective herbicides are now being used in agriculture, but this is still not enough. It is important that everything positive that exists at the institutes of the Academy of Sciences would also find a place at the institutes of the State Agroindustrial Committee. We are confident that our cooperation will increase even more.

Academician M.Ye. Beker, deputy director for scientific work of the Institute of Microbiology imeni Avgust Kirkhenshteyn, devoted his statement to questions of the further development of biotechnology.

Very responsible tasks have been posed for our science. This follows from the materials of the 27th CPSU Congress. The tasks of scientists of Latvia have been given concrete expression, and especially responsible work lies ahead for the collectives which support the priority directions. As is known, one of the directions of the joint program of scientific and technical progress of CEMA is biotechnology. Indeed, biotechnology by its discoveries can contribute not only to the cardinal improvement of health care, but also to the solution of such global problems as food supply, power engineering, environmental protection, and others.

I believe that we are narrowing too much the concept of biotechnology. This is not only the obtaining of some preparations by the fermentation method, like vitamins, hormones, and proteins. It is essentially a question of a fundamentally new approach of the control of biological processes, including in the plant and animal world; of the development of new strains--highly productive, stress-resistant, and virus-resistant. Such work to some extent has already been started in the republic, at the Priyekule Testing Station,

where by means of meristematic techniques they are obtaining virus-free potatoes. This applies to the increase of the population of highly productive animals, moreover, it is a question of a process which is tenfold more rapid than by means of classical selection. I believe that under the conditions of our republic the agroindustrial complex has great opportunities to use biotechnology for the intensification of production. It is also a question of obtaining a crop which is harmless to man, that is, it is necessary to decrease the use of harmful chemicals and the use of mineral fertilizers, but to obtain high yields by means of biological methods.

The draft of our program on biotechnology now consists of 10 subprograms. The majority of them serve the agroindustrial complex. And the fact that we have become accustomed here to hear what biotechnologists are now doing is just the beginning. The same kind of beginning is the biotechnological complex for fodder production which is being established at the Uzvara Kolkhoz, the system of the processing of waste products of farms at the Ogre Sovkhoz, the centers of cellular engineering at the base of the Ramava Farm, and others. In recent times we submitted the program on biotechnology for approval to the institutes of our academy and the system of the Agroindustrial Committee. Now it is necessary to coordinate promptly the final figures of the program in order in the very near future to submit the program for approval to the republic government.

What will the agroindustrial complex receive? New means of providing protein by microbe synthesis. Cellular engineering is making it possible to obtain strains of barley with an increased protein content, as well as root crops and fruit and berry planting stock. Of course, this is work not for a year, but for five-year plans. The preservation of fodders, and not only green matter, but also grain--moist grain--by natural means, for example, with lactic acid, is an important task. Special bacteria produce biologically such acid in the form of L-isomers, which is not harmful to animals. This would prevent significant losses of fodders. Our scientists are also working on this. It is also possible to store grain in an inert atmosphere, without drying, for which much energy is being consumed today--30 liters of liquid fuel per ton of grain. But our republic produces 1 million tons. It is necessary to add that in case of drying the quality of grain suffers greatly. For 2 years now experiments with inert gas, which was obtained from natural gas, have been conducted at the Uzvara Kolkhoz. We hope that biogas will also serve as a natural preservative both for green matter and for damp grain.

Without a comprehensive program an interbranch scientific technical complex is also needed. We called it Latbiotekh. This is an organizational form to which all performers of the program would belong, without a change of their legal status, but while working strictly in accordance with a specific program. Of course, since this direction is a priority one, it is possible to expect additional resources or the redistribution of the available ones. It would be advisable to convert the three laboratories that have now been organized (at the Uzvara Kolkhoz, the Ogre Sovkhoz, and the Ramava Farm) into interdepartmental laboratories with the now recommended status--temporary collectives, when it is possible to attract for a while a scientist from any other collective. Such temporary collectives would also be responsible for introduction and for the elaboration of recommendations on the large-scale

introduction of technologies. As a result we could expect substantial gains in the implementation of the biotechnological program. The program encompasses both academic scientists and sectorial and VUZ scientists. We have established a scientific educational center--this is the basis for the training of good personnel.

In conclusion Academician M.Ye. Beker emphasized that scientists will exert every effort for the assurance of the more rapid introduction of the results of their research and development.

Academician V.A. Latishenko, director of the Institute of Polymer Mechanics, devoted his statement to the problems, with which the institute is faced in accomplishing the tasks assigned to it.

Now, after the 27th CPSU Congress, it is possible to say the following: it is already clear what is to be done, but it is not always clear how this is to be done and how this is to be done more rapidly and better.

The work of the Institute of Polymer Mechanics, taking into account the evaluations of various commissions, is recognized as satisfactory. However, in light of the demands of the 27th CPSU Congress it is necessary to seek reserves for the further intensification and the increase of the quality of research and for the acceleration of the use of its results in practice. The institute changed over long ago to the experimental system of the remuneration of labor. Whereas in 1975 about 360 people worked at the institute, now 60 fewer people (more than 16 percent) do. At the same time the institute is now performing a larger amount of work and with a better quality. This is a result of the significant increase of the skills and activity of staff members, the extensive use of computers, the automation of experiments, and so on. However, the further reduction of the staff will hinder the most complete use of the scientific potential of the institute.

Further Academician V.A. Latishenko spoke about the need for the constant increase of the skills and political activity of scientists and technical personnel and the need to establish more and more efficiently working scientific collectives. Only the collective can obtain scientific results which revolutionize technical progress the most. It is also necessary to establish collectives for the introduction of developments, but in these collectives production and management personnel should constitute the absolute majority. The question of establishing collectives is one of the most important tasks in the matter of increasing the quality of scientific work. This is also the genuine concentration of forces in the main directions. This also concerns higher educational institutions and the directors of VUZ chairs. The intensification and the increase of the quality of research require constant renovation--the updating of the experimental base, the acceleration of the automation of the receipt of information, the further automation of experiments. In this matter we also expect assistance from superior organizations, in particular, in the improvement of supply and others.

At the 27th CPSU Congress much attention was devoted to the increase of the quality of industrial products. Much has already been done and very much more can be done by the establishment of order. However, in the future the

increase of product quality will depend on the possibilities of the efficient determination of a large set of quantitative indicators of quality.

The radical improvement of quality is one of the main levers of the acceleration of technical progress. It is necessary to bear in mind the extensive introduction of means of the efficient determination of the quantitative indicators of quality when carrying out the renovation of plants and constructing new ones, especially automated and robotized ones. It is necessary to note that everywhere robotization begins after the development and extensive use of effective means and methods of quality control at all stages of production.

A considerable reserve for the development of instruments for studying the properties of materials exists at institutes of the Latvian SSR Academy of Sciences. At the Institute of Polymer Mechanics 10 such instruments and more than 40 modified versions of them have been developed. Such developments exist at other institutes, at higher educational institutions, and in other organizations of the republic. All of them, as a rule, are for their most part electronic. They correspond to the basic directions of the development of industry of the republic. Many of these instruments do not have analogs in the world. Therefore, a plant of scientific instrument making, as has already been suggested previously, should be established, it is also a plant of means of control. Of course, first of all, it is necessary to speed up the establishment of the base of the Special Design Bureau of Scientific Instrument Making and the bases of other institutes.

Candidate of Technical Sciences A.E. Shenin, director of the Central Intersectorial Design and Technological Bureau of Robotics (the Center of Robotics) of the Institute of Physics, devoted his statement to questions of the development of robotics in the republic.

At the 27th CPSU Congress it was noted that a decisive role in the increase of the productivity and quality of national labor belongs to the machine building complex. The level of automation in the national economy during the five-year plan should be increased on the average by twofold and the pool of robots should be increased by threefold.

The Center of Robotics belongs to the machine building complex which is being established in the republic. The center, which is made up of 130 people, is working in two directions: it is developing, producing, and introducing hardware for the equipment of industrial robots and flexible machine systems; it is carrying out the planning, procedural supervision, and coordination of the introduction in the republic of flexible machine systems and industrial robots and is organizing cooperation in the production of robotic equipment.

In the first direction--the development of hardware for the equipment of robots--the collective has achieved definite gains. Tens of original, highly productive means of the orientation and feeding of parts to robots have been developed and introduced on the basis of the results of the research being conducted at the Institute of Physics. These developments, which conform in their technical level to the best foreign examples, have contributed to the introduction of industrial robots in the national economy. At the same time

the serious shortcomings should be indicated. The main one of them is the low total economic impact from the introduction of the developments of the center in the national economy. It is necessary to increase by seven- to tenfold the number of robotized complexes, which are being introduced with the use of means of technical equipment, which have been developed and produced at the center. For the accomplishment of this task it is necessary to increase significantly the technological feasibility of the components being developed and the degree of their standardization and to develop devices which have broader application.

It is possible to achieve a significant increase of the output of new items only by simultaneously expanding the experimental base. The lack of adequate capacities of the machinery, metal working, and other sections is the cause, which is common to many institutes and design bureaus of the Academy of Sciences, of the unsatisfactory introduction of new developments in the national economy. Therefore, the Academy of Sciences proposed to form a unified Engineering and Technological Center, the basic task of which is the development of design documentation and the production of small series of new items. It is envisaged to set up powerful design departments and subdivisions for the production of items.

The first steps for the start of the operation of the Engineering and Technological Center have already been taken at the Academy of Sciences: limits of the number for the recruitment of workers and engineering and technical personnel have been allocated, the range and size of the first series of produced items have been specified. Unfortunately, the further development of the Engineering and Technological Center in practice is not being carried out, since the question of the real provision of the center with facilities has not been settled. In 1986, 3,400 square meters were allotted to the center and the Antikor Special Design and Technological Bureau, but, as follows from the materials of the technical inspection of the facilities, the structural components of the buildings are in an extremely unsatisfactory condition, renovation, which according to an expert estimate will require 2.5-3 years and the outlay of more than 1 million rubles, is necessary.

In the past 1.5 years much attention has been devoted to the second direction of the work of the Center of Robotics--the planning and coordination of the introduction of robots in the republic. Jointly with the Machine Building Department of the republic State Planning Committee a republic program of the development and introduction of this equipment for the 12th Five-Year Plan was formulated. The program provides for the significant increase of the introduction of flexible machine systems. For example, the number of completely automated sections, lines, and shops will increase by nearly tenfold. However, the analysis of the program showed that in individual directions the introduction of this advanced equipment is being planned unsatisfactorily. The main shortcoming is the passive attitude of many industrial enterprises toward the extensive introduction of flexible machine systems and industrial robots. They are also being inadequately introduced in individual technological processes. Robots are being introduced in the painting sections at only three plants, for die casting--at only five, and in the molding of plastics--at six, while the introduction of robots in welding is not planned at all. The total number of robots, the introduction of which

is being planned in accordance with the program during the 12th Five-Year Plan, is also inadequate. At present work on the improvement of the program is being performed jointly with the State Planning Committee.

Timely and complete information on the development of this equipment in other cities and regions of the country and abroad has a great influence on the development of flexible machine systems. It is planned this year to transfer the available information on robots to computers. Much attention is being devoted to the start up of the first section of the republic demonstration test site of robotics. A display of operating models of robotics and means of their equipment will be located in the exhibition hall of the test site. Eight robotized complexes and a large display, which is devoted to the achievements of the introduction of robots in stamping at enterprises of the republic, are being prepared for the opening of the test site. The test site will play a large role in the transmission of information to enterprises of the republic.

In conclusion Comrade A.E. Shenin gave assurances that the Center of Robotics during the 12th Five-Year Plan will significantly increase its contribution to the fulfillment of the tasks which have been set by the party for the collective of the Latvian SSR Academy of Sciences.

Academician A.F. Blyuger, chairman of the Scientific Medical Council of the Latvian SSR Ministry of Health and prorector for scientific work of the Riga Medical Institute, devoted his statement to questions of the development of medical and VUZ science in the republic.

The institutes of the Academy of Sciences and of the Latvian SSR Ministry of Health have a very long-standing and good tradition of cooperation: during the 11th Five-Year Plan 23 themes were completed in accordance with comprehensive programs.

Academician A.F. Blyuger named a number of examples of the successful cooperation of academic and sectorial medical science of the republic. These are thermoluminescence dosimetry, computerization, new drugs, biomechanics, and others. The results in genetic engineering, which were obtained under the supervision of Corresponding Member E.Ya. Gren, have great prospects. The Academy of Sciences can have a real influence on scientific and technical progress in medicine via such a bridge alone as higher educational institutions and sectorial science.

Further Academician A.F. Blyuger cited a number of examples of when for various reasons the introduction of successful medical developments is being hindered. It is impossible to make any changes in medical equipment without the permission of the USSR Ministry of Health. For example, it is impossible to change even the tip of forceps without such permission. An instrument, which is very necessary for the dispensary system and makes it possible to make electrocardiograms significantly more easily, has been developed. The instrument is in operation in many places, but the All-Union Institute of Medical Technology after a period of 1.5 years expressed doubt about its advisability for practice. A difficult situation has arisen with the testing of drugs. The Pharmacology Committee requires the conducting of tests, which

in individual specific cases it is impossible in principle to perform. Another problem is connected with the fact that it is necessary to study the parameters of preparations in purebred animals, of which at present there are not enough. It would be desirable for the republic State Agroindustrial Committee to set up at one of the farms the breeding of purebred test animals.

The main path of the implementation of basic knowledge passes through sectorial VUZ science. The opportunity exists at the higher educational institution to perform a 1.5-fold greater amount of work with the available scientific potential. The appropriate orders also exist. However, a problem with the wage fund arises. The clients agree to pay any amount of money, but only do not provide a wage fund. And as a result the VUZ scientific potential stands idle.

The Commission for the Scientific Principles of Medicine of the Latvian SSR Academy of Sciences has completed the formulation of an important comprehensive program. Now 10 institutes of the republic Academy of Sciences are already participating in the development of everything that is needed by health care. Academician A.F. Blyuger expressed confidence that the shortcomings will be overcome and a significant contribution will be made to the development of health care.

Corresponding Member E.Ya. Lukevits, director of the Institute of Organic Synthesis, continued the discussion of the questions of drugs--one of the priority directions of research of the academy.

In conformity with the all-union program the Institute of Organic Synthesis during the 12th Five-Year Plan should bring up to commercial production the first batches of 10 drugs. These are new preparations: antitumor preparations, antileukemic preparations, preparations for the reduction of blood pressure, and others. The institute will do this. However, questions are arising--in what quantity is it necessary to produce these preparations and how many documents, which accompany their production, are needed? The plants, which will produce the preparations, are not specified in the program. It is merely indicated how much the Experimental Plant of the Institute of Organic Synthesis should produce, while it is unknown what there will be in the future. If a preparation by type corresponds to the Olaynfarm Plant, it will go farther. But if by type the preparation corresponds to other plants, very great difficulties arise. It is possible to understand why at the Experimental Plant it is necessary to produce complex preparations, but it is impossible to understand why it is necessary to produce there preparations which it is possible to turn over to other plants. The underlying reason for such a phenomenon lies in the fact that in the program it is not simultaneously recorded who will carry out commercial production. Instead of this a large number of programs, in which the same assignments are duplicated in full or in part, are being drawn up. The 13 organizations require reports on the same questions. Therefore, as a whole a unified state program on the creation of drugs, starting with development and ending with commercial production, is necessary.

Each preparation is developed over a long time. There are developments which have not yet gotten to production. The requirements of the Pharmacology

Committee of the USSR Ministry of Health have become such that it is necessary to do very much in order to prove the safety of a preparation. A number of checks are being made jointly with the Riga Medical Institute. However, there are checks, which are being performed by individual institutions in the country and require lengthy experiments. This issue will be settled with the construction of the biological complex, but its building will only begin this year. Very much also depends on an adequate number and quality of test animals.

The synthesis chemist is at the beginning of the process of developing a medicine. His work for many years has changed little. There is one solution here--the introduction of chromatographs for daily work. This will make it possible to decrease significantly the expenditures on reagents. The labor expenditures on the establishment of the optimum conditions for the occurrence of the process are also reduced. As a result: the combination of the automation of the experiment plus the biological complex plus proper planning will make it possible to substantially and actually speed up and expand the development of drugs.

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ACHIEVEMENTS, DEVELOPMENT OF WELDING

Moscow SLOVO LEKTORA in Russian No 5, May 86 pp 28-33

[Article by President of the Ukrainian SSR Academy of Sciences Academician Boris Yevgenyevich Paton, member of the CPSU Central Committee and Hero of Socialist Labor, under the rubric "Science and Social Progress": "Welding: The Scale, Achievements, and Development"; first two paragraphs are SLOVO LEKTORA introduction]

[Text] Speaking at the 27th congress of our party, Member of the CPSU Central Committee, Hero of Socialist Labor, and President of the Ukrainian SSR Academy of Sciences Academician Boris Yevgenyevich Paton noted that first of all it is necessary to strengthen significantly the orientation to basic research toward the solution of scientific and technical problems of great national economic importance and toward the obtaining of results in the form of major technologies, which ensure the all-round modernization of enterprises and entire sectors of our economy.

B.Ye. Paton tells how this task is being accomplished in practice on the basis of the example of the development of domestic welding science and equipment and of welding engineering.

General-Purpose Technology

Theoretical and basic research and scientific development in the area of welding technology in the end (regardless of the specific themes) are always aimed at the improvement of metal components and the development of their production. They also help to determine the possibility of the use of existing construction materials or the need for the development of new ones and for the optimization of the structural forms of metal products and their technological feasibility and to outline further means of increasing the durability, reliability, and serviceability of finished welded items.

Let us take, for example, the method of electroslag welding. Its use for the permanent joining of components without restrictions on the thickness and brands of metal changed radically the technology of a number of process stages, and first of all in heavy and power machine building. Thus, in our country a blank weighing 280 tons for a 1 million kilowatt turbogenerator was obtained for the first time in the world by means of electroslag welding.

The development and introduction of fundamentally new technological processes--electron-beam, plasma, and laser welding, new types of pressure welding, and methods of applying strengthening and protective coatings, which are based on welding technology--also caused substantial changes in the production of the latest equipment. The appearance of each new method of welding was marked by a qualitative leap in many metal-consuming sectors.

The idea of a comprehensive approach to the settlement of questions of the efficient designing and technology of the production of welded metal components is fruitful. It proved to be very effective in the introduction of the block method of the building of river and ocean-going ships: it makes it possible with a high degree of technological feasibility to build ships of any displacement and purpose.

Moreover, with the use of advanced welding equipment and technology new works for the production of large-diameter pipe for main petroleum and gas pipelines and unique power, metallurgical, and forge and press equipment were established in the country. Industrial methods of erecting various metal structural components, including all-welded bridges, are being developed on the basis of welding.

Now in various sectors of the national economy more than 75 million tons of metal components are produced annually with the aid of welding technology. The share of assembly and welding work in the total expenditures of labor on the production of machines and equipment does not exceed 25 percent (in the production of large construction and road machines it is about 60 percent).

It should be noted that the production of welded components is increasing at a leading pace. In just 3 years of the 11th Five-Year Plan it increased by 5.8 percent (the output of steel increased by only 3.4 percent and of rolled products--by 4 percent).

In such leading sectors of industry as machine building and metal working nearly half of the components being produced are welded. The systematic changeover to the welded version of formerly cast and forged components is continuing. Owing to this 300,000 tons of metal and more than 250 million rubles of capital investments were saved for the national economy and nearly 3,000 workers of various occupations were freed.

The stock of welding machines and equipment is being added to from year to year. Now more than 110 specialized plants and shops annually produce 312,000 units of arc welding equipment and more than 1 million tons of welding materials (four- to fivefold more than in 1958).

The Scientific Potential

Domestic welding engineering has a mighty scientific potential. More than 560 scientific research, planning and design, and technological institutes, higher educational institutions, design and planning bureaus, scientific production associations, as well as individual subdivisions of other enterprises and organizations, and 50 union and republic ministries and

departments are conducting research, development, and design work in the area of welding and related technological processes.

The coordinated efforts of scientists and specialists are making it possible to accomplish more and more complex and large-scale tasks. Technologies of the welding of various components made of new materials, which differ not only in chemical composition, but also in their initial state, are being developed (the controlled rolling of steel, hardening by heat treatment, and so on). Low-alloy steels of increased and high strength and high-alloy corrosion-resistant, heat-resistant, and heat-stable materials, copper, bronze, and other copper alloys, and aluminum and its alloys are being used more and more extensively for the welding of components. In chemical machine building, aeronautics, and several other sectors of industry titanium and alloys based on it are being used with a great impact. Welded components made of molybdenum, niobium, zirconium, and beryllium are appearing. The welding of polymer materials, first of all for the construction of pipelines and the production of items made of films, is being developed intensively.

In turn, the latest achievements of basic research in the field of arc physics, solid-state physics, and related fields of science, the dynamics of the formation of the welded joint, the interaction of metal with slags and gases, and the influence of the thermomechanical cycle of welding on the base metal give grounds to foresee the rapid devising and development of new technologies.

For example, new technologies of welding with controlled metal transfer and the use of arc plasma, an electron beam, and a laser are being successfully developed. New types of resistance welding are being devised. Pressure, mixed-gas, paste, slit-gap, and activated-wire welding is being improved. All this taken together, of course, will enlarge the boundaries of the use of welded components and will provide welders with highly economical tools of labor. While in the end the structure of the used welding methods will improve, the share of advanced technologies will increase, quality will increase, and the power-output ratio and labor intensiveness of welding work will decrease.

Intensification and Thrift

The range of application of welding in the national economy is very broad. The level of mechanization of welding work is constantly increasing. At present it has reached 56.5 percent (in machine building, nearly 79 percent). Thus, arc welding processes are being mechanized, mainly by using so-called semi-automatic welders. They increase labor productivity (as compared with manual welding) on the average by 30-40 percent. Their operation does not require substantial capital outlays. That is why semi-automatic machines have become widespread not only in our country.

However, unfortunately, semi-automatic machines have begun to be used even where it would be possible to use with a great impact completely mechanized arc welding (of course, after the appropriate equipment of production). This negative trend is still being maintained, for example, in machine building. It is possible to change it. It is necessary merely to approach in a new way

the evaluation of the technical and economic level of production and, what is the main thing, the present technical possibilities of advanced methods and means of the mechanization and automation of labor.

What problems worry today scientists and specialists in the area of welding engineering?

The mechanization of manual arc welding in construction remains urgent. True, some experience in its mechanization has already been gained here. At the construction site of main gas and petroleum pipelines along with the submerged arc welding of "rotary" joints they are successfully using flux-cored welding with the induced formation of the weld and the flash welding of "nonrotary" joints.

The labor of welders in the installation of welded components has still been inadequately mechanized. Self-shielded flux-cored welding with the induced formation of vertical welds and circular welds on the vertical plane is being used only in individual cases. Argon-arc welding with the free formation of welds and, in case of the building of thick-wall components, electroslag welding are used at times. In most cases the elements of metal components are welded manually with the use of individual electrodes.

Self-shielded small-diameter flux-cored welding may become a serious "competitor" of manual arc welding. For this it is necessary to develop light, reliable, small-scale equipment which is capable under the conditions of the installation of metal components of helping the welder to perform his work more rapidly and more reliably.

An advanced technology of the welding of elements of reinforced concrete components under both installation and, in part, plant conditions also has to be developed.

Among the large number of diverse scientific, technical, and production problems facing welders, the main one is the development and extensive use of technological processes which ensure a saving of manpower, material, and energy resources. This task will also remain the basic one during the present 5-year period: for the intensive development of welding engineering is possible only on the basis of resource-saving technologies.

The complete mechanization and automation of welding engineering are the main means of the further saving of manpower resources. Its present stage differs in principle from the preceding stages. The use of industrial manipulators--robots, as well as control systems based on microprocessor equipment is characteristic of it.

It is possible in individual cases to effectively use welding operations with a "rigid" control program without any changes of the existing technology of producing welded blanks. At times for this it is sufficient to use the thermal cutting of blanks on NC machines.

However, in general the use of robots with "rigid" control requires the radical improvement of the technology of the production of blanks and their

subsequent machining. Often this entails unjustifiably large capital outlays, and at times (given the present level of the technology of machining metals) becomes altogether impossible.

In this case robots with adaptive control are needed. But the increase of the level of adaptation, "intelligence" of a robot not only increases the cost, but also decreases its reliability. Therefore, the optimum degree of adaptation is necessary. Consequently, the use of robots requires the development of the production of blanks for the welding of assemblies and parts at a significantly higher technical level. This is one of the basic conditions of the successful mechanization and automation of welding engineering.

Along with manipulators simple transport robots with position control are being used effectively in welding engineering. They make it possible in combination with other mechanisms and devices to develop automatic lines and individual sections, which produce the most diverse items. A section for the welding of small parts has been set up at the Moscow Motor Vehicle Works imeni Likhachev. It consists of several general-purpose spot welders, which are equipped with vibrating bins (they achieve the required orientation in space of small stamped parts), and transport robots for the delivery and assembly of parts in special jigs. By changing the jigs such a complex is easily changed over to the production of new parts. A similar complex with a general-purpose friction welder provides the Melitopol Motor Plant with bimetallic blanks of valves for the new model of the Zaporozhets. It is possible to cite many more examples of the efficient use of general-purpose welding equipment in combination with transport robots. They do not require large capital investments and ensure a substantial increase of labor productivity.

A practicable means of increasing labor productivity, improving working conditions, and increasing the quality of welded components (first of all at machine building plants and plants of metal construction components with small-series and custom production, where 55-75 percent of all welded products are produced) is the creation and extensive use of completely mechanized workplaces or sections. The welding equipment, manipulators, standardized attachments, and other equipment and devices, which are necessary for the equipping of such workplaces and sections, have already been developed. Many of them are series produced. It is necessary merely to use them skillfully, while observing the scientific organization of labor and sanitary and safety regulations. The work on the standardization of completely mechanized workplaces and sections is now being completed. The task is to produce centrally the equipment necessary for them and to supply it in complete sets to the users.

An important means of saving manpower resources is the efficient choice of the method of welding. The replacement under the conditions of mass production of arc welding with butt resistance welding in a number of cases increases labor productivity by tens of fold, decreases the production area, and eliminates several technological operations. (The additional capital investments in this case are recovered quite rapidly.) In the production of items with a wall thickness of greater than 50-60 millimeters the use of electron-beam welding instead of multipass arc welding is often economically justified: a multifold

increase of labor productivity is achieved. The changeover from a normal to a slit groove is also a effective step in case of the arc welding of relatively thick metal.

Significant reserves of the saving of metal owing to the use of the precision and low-waste laying out of rolled stock exist in the sphere of the production of welded metal components. NC thermal cutting machines make it possible to "cut" rolled stock with the least losses of metal and to product blanks with the minimum tolerances for subsequent machining.

The use of lines of the waste-free laying out of construction reinforcement is effective. The butt-joining machine welds the reinforcement, which has arrived from the metallurgical plant, into a continuous strand, while at the same time cutting off pieces of reinforcement of the necessary length. In the same way it is possible to lay out coiled and strip steel. Waste-free laying out on the basis of the combining of metal by butt welding is being used successfully at the regional engineering center for the preparation of metal components for consumption in production and the use of secondary resources, which was established by the Ukrainian SSR State Committee for Material and Technical Supply jointly with the Ukrainian SSR Academy of Sciences.

The specific metal content of welded components can be reduced substantially as a result of the in-depth study and use of parameters, which determine the efficiency of the use of rolled metal products in components. Thus, it is possible to decrease substantially the cross-sections of fillet welds of tee, lap, and corner joints. The drafted new provisions on the determination of the dimensions of their legs show that the cross-sections of fillet welds can be reduced to one-half to two-thirds. The USSR State Committee for Construction Affairs has already included in the norms of the designing of steel components new provisions on the designing of supporting welds and recommendations on the dimensions of off-design connecting welds. Several industrial ministries have also put into effect special standard documents which regulate the designing of components with reduced cross-sections of the fillet welds.

The use of these new provisions can reduce the saturation of welded components with built-up metal by 34-40 percent. At the same time manpower resources, welding materials, and electric power are saved.

The use in construction and machine building of rolled ferrous metal products, which are differentiated by strength properties, has become an exceptionally promising direction of the reduction of the metal content of welded components. At metallurgical plants it is possible to differentiate rolled products practically without additional capital investments and the increase of the staff of workers. The use of rolled products that have been broken down by groups of strength (their output in 1984 came to 5.6 million tons and will increase) makes it possible to save on the average up to 10 percent of the metal.

The extensive use in welded components of metal hardened by heat treatment is one of the most effective means of saving.

The saving of such welding materials as electrodes, wire, flux, and shielding gases is also of no small importance. A large amount of metal, scarce ferroalloys, and various nonmetallic minerals of high quality, as well as electric power is consumed for their production. The observance of strictly substantiated dimensions of welds, the use of the method of slit grooving of blanks, the use of efficient modes of welding with the minimum sputtering of metal and with the least consumption of flux and of the airtight packaging of electrodes and wires, which ensures their long-term storage--all this can save many tens of thousands of tons of expensive filler materials.

A Two-in-One Task

The intensive development and increase of the technical level of welding engineering and the decrease of the total need for manpower, materials, and other resources to a significant extent depend on the development of the material and technical base of welding.

In spite of the fact that we have the most advanced welding equipment and technology in the world and the necessary reserve of scientific and technical ideas and developments, the structure of the production of the basic welding materials and welding equipment still lags significantly behind the requirements of modern welding engineering. Judge for yourself. The annual production of coated electrodes now exceeds by twofold the total output of welding wires of all types, while one-seventh as much equipment is produced for mechanized welding than for manual welding.

As before, the assurance of a leading growth rate of the production of welding wires remains an urgent task during the 12th Five-Year Plan (and beyond it). This especially concerns alloyed wire of small diameters and self-shielding flux-cored wire (with the simultaneous systematic decrease of the production of coated electrodes). The output of advanced highly mechanized and automated electric arc welding and mechanical arc welding equipment and means of the complete mechanization of welding operations also has to be increased substantially. The decisive role here belongs to enterprises of ferrous metallurgy and the electrical equipment and machine tool building industries.

How is a reliable base to be provided for the further intensification of domestic welding engineering and its retooling on a modern technical basis? In order to achieve success, in my opinion, we should act simultaneously and purposefully in two directions:

1. Improve continuously and utilize fully the mechanism of the rapid development and transfer of scientific ideas to the sphere of production.

2. Create the material and organizational basis for the increase of the readiness of welding engineering for the truly mass and efficient use of the most advanced welding equipment and technology.

Experience in the accomplishment of this two-in-one task exists. A search for new organizational forms of the cooperation of science with production is under way. These are both the establishment of temporary creative collectives of scientists and production workers and the improvement of the interaction of

academic and sectorial institutes on the basis of the increase of their mutual interest in the achievement of the end results. These are also the new problem-oriented scientific production subdivisions--engineering centers--which are being established on the initiative of the Ukrainian Academy of Sciences, and much more.

We are proud of the high rating in the Policy Report of the CPSU Central Committee of the initiatives of the party organization of our republic in the matter of establishing interbranch scientific technical complexes, engineering centers, and resource-conservation centers. Powerful interbranch scientific technical complexes will become an important unit of the new structure of management. We are convinced that in a number of cases they will make it possible in a short time to attain leading levels in the world in the most important directions of scientific and technical progress.

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PROMOTION, DEVELOPMENT OF SCIENCE IN LITHUANIA

Moscow SLOVO LEKTORA in Russian No 5, May 86 pp 24-27

[Interview with Vice President of the Lithuanian SSR Academy of Sciences Vitautas Antanovich Statulyavichyus, director of the Institute of Mathematics and Cybernetics of the Lithuanian SSR Academy of Sciences, chairman of the Latvian SSR Society for Knowledge, and USSR State Prize winner, by I. Zykova: "To Work With Love"; date, place, and occasion not given; first four paragraphs are SLOVO LEKTORA introduction]

[Text] In the daily work routine of Vice President of the Lithuanian SSR Academy of Sciences Vitautas Antanovich Statulyavichyus, chairman of the republic Society for Knowledge and USSR State Prize winner, every hour is squeezed to the limit. As far as his colleagues and friends recall, it has always been that way. This is the life style of Statulyavichyus.

For many years he has managed the academy's Institute of Mathematics and Cybernetics--one of the more effective ones in the republic in research results. Prior to being elected last year as vice president and chairman of the republic Society for Knowledge for 20 years he headed the Vilnius City Organization of the society. Add to the named duties the duties of a deputy of the Lithuanian SSR Supreme Soviet and chairman of one of its commissions and lecture activity, which has become a fundamental, truly integral part of his entire way of life.

In practically all rayons of Lithuania scientists and production workers, school children and students have heard the speeches of Vitautas Antanovich--a brilliant, inspired speaker, a fervent promoter of knowledge, a scientist, who is in love with his occupation and strives to "recruit" to the field of science, which is close to him, everyone who has the gift of a mathematician....

And, perhaps, precisely this trait explains the fact that the academician is constantly surrounded by people. An interested, attentive attitude toward colleagues and their proposals and ideas, profound and diverse erudition, tact in dealings, natural charm and benevolence in combination with great adherence to party principles, self-control, and the ability to consistently bring a begun job to the logical result also create, so it seems, a picture of the

modern Soviet scientist, manager, and public figure, who is called upon today along with others to be in the forefront of scientific and technical progress.

[Question] Vitautas Antanovich, what changes and revisions, in your opinion, is it necessary to make in the position of the scientist who is a promoter of knowledge today, when the task of accelerating the socioeconomic development of the country has been specified as strategic?

[Answer] Now we are all saying very much about scientific and technical progress, which has been defined as the main lever, the core of the acceleration of all the socioeconomic development of the country. However, a portion of the people still understand this task simply as the acceleration of technical progress. But it is a question of scientific and technical progress, and many former, though even proven, methods and schemes of acceleration are useless today, for it is a question of a fundamentally different, revolutionary approach to scientific and technical progress.

This is waste-free and unmanned works, when only a given technology and a computer will interact in the shops, this is plasma and "solid" flame machining, laser and powder technology, biotechnology, and cell engineering. The cycle: basic research--new technologies--rapid introduction in production--products of a high international level (let us add, ones which have wherever possible a low production cost), is now becoming basic.

Signs of the new stage of the scientific and technical revolution are now clearly visible in the developed capitalist countries. Microelectronics has made drastic progress and is finding more and more extensive use in science, industry, and design work. In the opinion of specialists, biotechnology, molecular and genetic engineering, and a number of other fields have approached the threshold of the same kind of breakthrough.

Production is becoming more and more science-intensive. Actually every sector of the national economy requires multilevel scientific service and often at the level of basic research.

Under these conditions our personnel and the broadest contingent of production workers and scientists should receive thorough and systemic information, both on the present state of knowledge as a whole and on everything new that is entering one field or another. This task is of the greatest scale. Hence, too, the increasing responsibility for the level of promotion of scientific knowledge and the need for the stimulation of the lecture activity of scientists, specialists, and production managers.

You have probably heard the following expression--"half-life." For many advanced fields, such as several directions of physics, microelectronics, cybernetics, and mathematics, this period comes to 4-5 years, for several others it is somewhat longer. Hence the need to update fundamentally the knowledge of specialists in the named and other priority directions, which govern technical progress, at least every 5 years. With allowance made for the increase of skills we have organized in the republic tens of faculties and cycles for urgent problems of natural science and technical science knowledge. These are, for example, the cycles on the control of technological processes,

genetic engineering, the creation of data banks, and so on. In all 90 people's universities of the natural science and technical science type are now operating here. More than 100,000 students are studying at them.

Contracts on the creative cooperation of academic institutes and enterprises are also prevalent in Lithuania. The primary organizations of the Society of Knowledge are also parties to them. Their goal is to inform the active production workers at large about everything new that exists in the given field in our country and abroad. Incidentally, the idea of developing such contracts of cooperation originated in the organizations of the society.

As vice president I personally monitor and bear responsibility for the introduction of scientific developments in practice. We are posing the task that institutes and scientists would be responsible not only for the results of research in their field, this especially concerns the exact sciences, but also for the standards of the republic in the given direction of knowledge and for having everything done conform to a good world level.

We are devoting much attention to the training of the young generation. Thus, in particular, our Institute of Mathematics and Cybernetics is the patron of 20 schools. The school in Utyatskiy Rayon, where I was born, is also among them.

We are taking part in the organization of contests of upperclassmen and are engaging in earnest in the improvement of the skills of instructors. Thus, in 1984 the Institute for the Improvement of Skills of Teachers, the Ministry of Education, the republic Society for Knowledge, and the Institute of Mathematics and Cybernetics jointly conducted 20-day lessons (10 days during winter vacation and 10 days in the summer) for mathematics instructors of secondary schools.

Whereas previously during the lessons at the Institute for the Improvement of Skills a large portion of the time was assigned to how to give a course on a subject, now the lessons were organized differently: before lunch--the examination and solution of the most difficult problems of contests (the goal is to increase the level of knowledge of those graduating from secondary school), while during the second half of the day--familiarization of instructors with the laboratories of the Institute of Mathematics and Cybernetics. We showed the entire "forge" of science--laboratories, instruments, and methods of research. We showed it not only to mathematicians, but also to biologists, physicists, and linguists, so that the teachers would have a clearer, more graphic idea of what science looks like today and what demands it is making on future personnel.

Last year the Institute of Physics gave the same type of course for instructors. Correspondence schools in mathematics and programming have been organized and have been operating successfully for many years now.

It is also fundamentally important to take into account in lecture work the following things. Not the numbers and tons, but the quality of products has become the main thing today. People here say: "I am not such a rich person to buy a poor thing." Our country is also not that rich in manpower and

material resources, clear lakes, and forests that we would allow ourselves to produce poor items or to do harm to the environment. We do not need poor or even average products. We need only good and very good ones, which conform to the world level.

The qualitative updating of products and the modes of their production presumes the comprehensive use of mathematical models and computers, the latest achievements of physics, chemistry, and biology, that is, a multilevel approach in scientific research is necessary. But this is only one aspect of the question. The point is that previously we also did not sweat very much over the practical application of scientific achievements. And still at times we avoided specific requirements of the day. Our motto was, for example, the following: create an automated control system. But for what? Precisely where will it operate, what economic impact will it yield? The answer to these questions was often put off to the future. Now the task is specific: time and manpower and material resources should be concentrated on the output of good products. To manufacture things, which no one will buy, and to product equipment, which enterprises do not need, is equivalent to the theft of national property.

The main thing today is to ensure in practice the union of science and production.

A qualitatively new level of creative cooperation, when often an idea, even one expressed as if in passing or in the form of a hypothesis, receives further development and substantiation and finds expression in instruments being devised and technologies being developed, is created in joint operations. It is pleasant to note that several such joint operations were commenced precisely on the Days of Science.

However, at times we underestimate the influence in this union of production on science. It must not be forgotten that precisely the production, high-class base of leading enterprises and associations makes it possible to develop experimentally and to assimilate in the shortest possible time new advanced equipment. Precisely the union of science and production makes it possible to obtain the most effective results and to shorten drastically the time of the introduction of scientific developments.

[Question] The experience of the Lithuanian SSR in the establishment of multilevel scientific production associations (NPO's) has aroused great interest in various regions of the country. Please tell us in a little greater detail about the principles of their work, their structure, and the role in them of organizations of the Society for Knowledge.

[Answer] We regard scientific production associations--intersectorial centers of interactions, which unite academic and sectorial institutes and industrial enterprises for the solution of one important national economic problem or another--as a decisive direction of scientific and technical progress. Let us take, for example, the Elektronika Scientific Production Complex, which was established about 4 years ago. Its task is the automation and robotization of production with the use of computers and the development of new semiconductor and electronic equipment.

Two academic institutes—the Institute of Semiconductors (as the leading one) and the Institute of Mathematics and Cybernetics—four sectorial institutes, two higher educational institutions, and seven plants were included in the complex. Thus, physicists, mathematicians, and engineers--the developers and producers of electronic equipment--were united for permanent work in this scientific production complex, which has an exceptionally strong scientific production base. The task of the extensive use in production regardless of its departmental affiliation of basic knowledge and technical achievements, and not only, as happens at times, the introduction in practice of the results of the research of "one's own" institutes, was posed.

In the incomplete 4 years of its activity the collective of the Elektronika Complex has completed more than 100 jobs, which yielded an appreciable economic impact. Among them are the development of automated control systems and microprocessor means of control of the production of picture tubes at the Panevezhis Ekranas Plant and the Shaulyay Television Plant imeni 40-letiya Sovetskoy Litvy, the increase of the quality and technical level of the production of televisions, the development of specialized integrated circuits and semiconductor sensing elements (sensors) for machine tool building and electrical equipment enterprises, the development and production of new electronic equipment for medical diagnosis, and others.

It is important that the Elektronika Complex brings developed models and mockups up to the pilot production of small series. Thus, for example, the Vilnyale-2 and Vilnyale-3 microcomputers with software, which were developed by the joint efforts of the Institute of Semiconductor Physics and the Institute of Mathematics and Cybernetics of our academy, sectorial institutes, and the Shaulyay Television Plant, are operating today in the shops of enterprises.

Associations in vibratory equipment, electroplating technology, and laser technology have also been established in the republic. The organization of associations in biotechnology, construction and construction materials, and environmental protection is planned. I will note that the problem of developing waste-free technologies is assuming greater and greater practical urgency, and first of all in the sense of the protection of the health of man and the preservation of ecological equilibrium.

The associations being established can also be of a temporary nature or can be formed for some specified period for the accomplishment of a specific task. The main advantage of such scientific production associations, in my opinion, is that they make it possible to develop a system which is capable of accomplishing the cardinal tasks of scientific and technical progress.

Since questions of quality have been made the cornerstone of their work, the drafting of an intense plan on the production by enterprises of new equipment and on the introduction of the most advanced technologies is becoming an indispensable condition of the successful activity of such scientific production associations. Such plans and the progress of their implementation are discussed at meetings of the managers of all the subdivisions of the scientific production associations. Here a special creative atmosphere

arises, it is ascertained who of the participants can help each other and how. And it is a matter not of somehow extricating oneself and fulfilling the plan at any price, but of producing products of the highest class. Thus, as you see, the possibilities of the optimum use of personnel, their knowledge, and experience are being created.

And in conclusion the response to the posed question about the participation of organizations of the Society for Knowledge in the work of associations. There are quite a large number of versions of such participation. In our practice series of lectures on some special problems or others are used extensively. Already when drafting the plan of work of scientific production associations it is specified precisely which series, when, and for what group of specialists or specific contigent of workers it is necessary to give. Thus, as you see, the organizations of the society have taken a quite responsible place in scientific production associations.

[Question] Vitautas Antanovich, I know that, despite being very busy, you often deliver lectures to various audiences. What influence does lecture activity have on you personally and does it give you satisfaction?

[Answer] Yes, it undoubtedly does. And very much.

In our republic in general the very respectful attitude toward lecture work formed traditionally. Back during the first years after the end of the Great Patriotic War in our, at that time still very young Soviet republic for many well-known Lithuanian scientists it became as if a kind of bridge for the establishment of closer contact with the broad masses of workers and afforded them opportunities for public activity.

Today we also value very highly the opportunity to speak from the platform. I believe that not one, even very prominent and very busy, scientist would ever turn down such an opportunity. I recall a conversation with the American delegation, which recently took place during the holding in Vilnius of the International Mathematical Conference. Thus, when we told our American colleagues about our public appearances and about the afforded opportunity to associate, to speak with people, they sincerely envied us. Why do scientists need such contact?

Here, for example, I am a mathematician. Mathematics today has become the language of science. The dream of every scientist is to shape his own system and field mathematically. The point is that mathematical simulation makes it possible to use the computer and to conduct a computer experiment instead of an expensive and lengthy physical experiment. It is very important to develop mathematical models of such complex phenomena as plasma, gases, laser beams, microcosms, elementary particles, biological models, models of machines and mechanisms, and so on. But since the research mathematician is somewhere, conditionally speaking, in the middle of the experiment, he does not usually see either its beginning or its end. And, therefore, the need for contact and to see and sense the specific application of your knowledge, even through influence on other people and their level of mathematical thinking, is great. Public appearances give the most profound internal satisfaction.

[Question] And another question. Do you, Vitautas Antanovich, have any fondest dream, your own, figuratively speaking, favorite child, whom you would like without fail to bring into the world, to give strength....

[Answer] The basic field of my activity is basic research. The collective of the Institute of Mathematics and Cybernetics, including myself, is concentrating efforts on the most urgent directions for the national economy. These are probability theory in the very broad sense, stochastic differential equations, numerical methods, mathematical logic, and the use of mathematical methods in economics. It is very important for us to enter practice at large, so that computer technology would find universal use and people would sense its real return and benefit. Thus, already today at our neighboring Institute of Semiconductors, of which Academician Yu. Pozhela, president of the Lithuanian SSR Academy of Sciences, Lenin Prize winner, and Hero of Socialist Labor, is the scientific supervisor, approximately 75 percent of all the operations are first simulated mathematically, a computer experiment is conducted, that is, they make models, conduct research, and then check the results physically. It seems necessary that departments for the computer experiment for the checking of the optimality and reliability of proposed designs and solutions would be organized at all sectorial institutes and at design bureaus.

In order to introduce the results of our research more rapidly into production, we have organized under the Institute of Mathematics and Cybernetics (and this is one of first in the country) a plant of computerized assemblies and software. One of its tasks is to supply with programs the plant for the production of sensors and computers for the control of technological processes, which was set up under the Institute of Semiconductors, and the laser plant, which was set up under the Institute of Physics. We, figuratively speaking, as if "animate" these instruments and incorporate "intelligence" in them.

It is very difficult to develop the physical part of microprocessors and computers, but I believe that 80 percent of the success of their operation is connected with good software.

In specifying the priorities of our research, we are striving to select precisely the themes of the greatest practical importance. Thus, for example, during the last five-year plan a number of latest instruments for medicine were developed at the Elektronika Complex. Among them is an echo tomograph, which makes it possible to see the entire human body and to detect, if they exist, the most minute tumors.

During the commenced five-year plan we will concentrate efforts on the development of software for the automation of design and on the development of school, household, and professional computerization. Whereas previously we gave medicine much help, now the turn of biologists to be helped has come. We will also broaden the access to other fields.

My dream is that every job and every thing would be performed with love and that everything, of which the mind, hands, and heart of man is capable, would be invested in them.

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DEVELOPMENT OF INVENTING, EFFICIENCY PROMOTING IN BELORUSSIA

Minsk NARODNOYE KHOZYAYSTVO BELORUSSII in Russian No 4, Apr 86 pp 4-5

[Article: "The Intellectual Potential of the Specialist"]

[Text] The implementation of the policy of the acceleration of the socioeconomic development of the country, which was adopted by the 27th CPSU Congress, depends to a decisive degree on the further increase of the role of the human factor. The labor, talent, and valor of the Soviet people are the basis of all our achievements in the building of communism and a guarantee of the successful accomplishment of the new imposing tasks. And therefore, summarizing what has been done, we see behind the figures and facts the flight of the creative search of workers, kolkhoz farmers, and the intelligentsia and their increased intellectual potential.

In the Policy Report of the CPSU Central Committee to the party congress it is noted that in the quarter century since the adoption of the third CPSU Program the Soviet Union had achieved impressive gains. The fixed production capital of the national economy increased by sevenfold. Thousands of enterprises were built, new sectors were created. The national income increased by nearly fourfold, industrial production--by fivefold, and agricultural production--by 1.7-fold. The real per capita income of the population increased by 2.6-fold, public consumption funds--by over fivefold.

The achieved results are directly dependent on the constant concern about the all-round development of the Soviet people, on the creation of the conditions for studies and professional growth, and on the display of capabilities and talents, of which there is an inexhaustible source in the people. On the other hand, they made it possible to increase even more the assets being allocated by society for these purposes. In the country a changeover to a universal secondary education has been made. The number of people, who have graduated from higher educational institutions, has increased by fourfold. At present in our republic 84 percent of the employed population has a secondary and higher education. In all 33 higher educational institutions, including 3 universities, tens of tekhnikums, and a branched network of vocational and technical schools are training skilled personnel. Tens of thousands of people, a third of whom have academic degrees, are working in the sphere of science alone. Hundreds of thousands of engineering and technical personnel

are employed in the sectors of the national economy. The ranks of efficiency experts, inventors, and production innovators are increasing.

In other words, the republic has an enormous scientific and technical potential. This is making it possible to solve the most difficult problems of science and technology at the level of world achievements. Many scientific collectives have to their account developments which are capable of significantly increasing production efficiency and product quality. Research on biotechnology and genetic engineering, microelectronics, and the extensive use of robotics and microprocessor equipment, as was noted at the 30th Belorussian CP Congress, is affording great opportunities. During the past five-year plan about 1,000 new types of machines, equipment, and instruments were developed, the production of more than 1,700 types of items was assimilated and their output was begun. The fund of the saving, which was derived from the introduction of innovations of efficiency experts and inventors, exceeded during these years 1 billion rubles.

As is known, during the 11th Five-Year Plan the gross national product of Belorussia increased by 26.5 percent, the national income increased by 32.5 percent with an assignment of 23.3. percent, and its average annual growth rate came to 5.8 percent against 5.1 percent during the preceding 5 years. The productivity of national labor increased by 30 percent. The materials-output ratio of the gross national product decreased by 3.4 percent. For the successful fulfillment of the State Plan of Economic and Social Development of the Country for 1985 and the assignments of the 11th Five-Year Plan and for the worthy greeting of the 27th CPSU Congress the Belorussian SSR was awarded the Challenge Red Banner of the CPSU Central Committee, the USSR Council of Ministers, the All-Union Central Council of Trade Unions, and the All-Union Komsomol Central Committee.

Following the economic indicators the names of the best workers, whose contribution to their achievement was most significant, were named with much gratitude and warmth from the rostrum of the Belorussian CP Congress.

All of them are representatives of collectives which are well known for their great labor achievements. This once again confirms that the possibilities of a person and his energy are revealed most completely where an atmosphere of intense competition and creative and fruitful work reigns. Many good words meant for the Orsha Krasnyy bortets Machine Tool Building Plant have been said in recent times. This enterprise produces precision, hence, high-precision surface-grinding machines. And it makes them at a technical level which exceeds the world level. Not by chance have firms of 87 countries, including England, the FRG, Sweden, Italy, and Japan, become buyers of the products of the Orsha workers.

The administration, the party organization, and the public organizations of the enterprise are skillfully subordinating to the task of the constant improvement of production and products an entire set of economic, social, and educational measures and are using the intellectual potential of the entire collective. The plans of retooling are drawn up without fail with the participation of all personnel--through workers' and trade union meetings, permanent production conferences, and councils of the All-Union Society of

Inventors and Efficiency Experts and the scientific and technical societies. Moreover, they do not duplicate each other, but complement each other, making room for the initiative and creative work of the plant workers. Hundreds of proposals are submitted for the planned discussions of problems. The fulfillment of the ones, which have been approved and adopted, is guaranteed by the system of standards of the enterprise, which as a whole forms the system of control of the quality of labor and products.

Particular attention is being devoted to inventing and efficiency activity. A clear procedure of the passage of proposals, their implementation, and the selection of the ones, which should be introduced immediately, has been established. This makes it possible to aim technical initiative in the basic direction of technical policy. During the past five-year plan 126 basic problems were posed for the efficiency experts of the plant and all of them were solved.

The Mogilev Strommashina Plant is firmly keeping the title of best enterprise in the USSR Ministry of Construction, Road, and Municipal Machine Building. In all 16 types of machines are being produced with the State Emblem of Quality. The products of the enterprise have found buyers in 27 countries of the world. And here the successes in many respects are connected with the fruitful activity of the plant organization of efficiency experts and inventors, which N.I. Pozhidayev, deputy chief of the foundry and author of 60 introduced proposals with a total economic impact of 100,000 rubles, heads. While in all the efficiency proposals, which were introduced in 1985 at this comparatively small enterprise, yielded a saving of more than 900,000 rubles.

The experience of the Molodechno Plant of Semiconductor Power Rectifiers merits the most extensive dissemination. Here they decided that every engineer is obliged to take part in creative technical work. Moreover, the amount of the annual economic impact, which is planned in the personal creative plans, should be not less than the annual wage fund.

The movement of efficiency experts and inventors, in which more than 166,000 people are actively involved, is an important reserve of the acceleration of scientific and technical progress. It yields an enormous national economic impact without obvious expenditures. The enthusiasts of creative technical work, who are absorbed in their work, are both the authors and the developers of their own innovations. They are ready, regardless of their personal time, to aid their introduction. Moreover, not so much the future author's reward as the longing for a creative victory prompts them to this. But this fervent interest frequently comes up against cold indifference on the part of the people, whose duties include concern about the development of creative technical work and on whom the introduction and, hence, the public recognition and material rewarding of the labor of the innovator depend. Unfortunately, there are still many instances, when efficiency experts and inventors are forced for years to "force" their indisputably valuable developments through bureaucratic barriers. It happens that the managers of enterprises and the financial services attempt to save on the payment of authors' rewards, shielding themselves in so doing, as with a shield, ostensibly with zeal for state interests. Not everywhere are they giving proper assistance and support to innovators and showing concern for the

development of creative technical work and its orientation toward the solution of the urgent problems of the improvement of production. In recent years the effectiveness of efficiency and inventing work at the enterprises of a number of ministries has decreased, the "worth" of inventions has declined. In Minsk Oblast, for example, one proposal in six remains unintroduced. It is possible, of course, to calculate the amount of the economic impact, which the national economy could have, but did not receive. And it will be considerable. But the costs of the social and educational level, which are less amenable to calculation, but are indisputably significant, should be added to it.

Party, trade union, and Komsomol organizations and economic organs, it is indicated in the materials of the 30th Belorussian CP Congress, are obliged to improve the activity of the organizations of scientific and technical societies and the All-Union Society of Inventors and Efficiency Experts, to improve the system of scientific and technical information, to develop in each worker the aspiration to participate in the improvement of equipment and technology, and to enlist boys and girls more actively in this. The integrated system of work on the development of the creative scientific and technical work of young people, the need for the establishment of which was also spoken about at the congress, will become an important unit of the improvement of the work of the school, vocational guidance, and the training of specialists at higher educational institutions and tekhnikums. For the future of science, production, and, hence, our country is being laid here. In the process of instruction undergraduates and students should acquire a taste for creative and research work and should participate in the introduction of its results in production.

Important steps have been outlined in the country on the increase of the efficiency of the work of scientific research institutions. They concern the questions of the stimulation of labor and new forms of the interaction of science and production. Much has been done on the strengthening of the material and technical base of academic and sectorial science. The creative return of scientists of the republic is increasing. During the years of the past five-year plan staff members of the Belorussian SSR Academy of Sciences made 4,300 inventions. The economic impact from the introduction of innovations came to 786 million rubles--twofold more than during the 10th Five-Year Plan.

But the decisive turn of science toward production and of production toward science has not yet occurred. Frequently even major inventions and discoveries, which promise an enormous national economic impact, still do not find practical application for a long time, the introduction of developments is dragged out for years. It is possible to regard the development of automated part-rolling mills as an important task of the Physical Technical Institute. The use of 50 such mills at machine building enterprises of the country decreased by 40 percent the consumption of metal and increased labor productivity by two- to threefold. There are also no analogs in the world of the percussion presses which were developed here. The introduction of just one of them saves up to 2,000 rubles a year. They sharply reduce the expenditures on the preparation of production. The interdepartmental commission recommended them for series production. While after these

characteristics it will be especially surprising to learn that the path of the innovations from development spanned...three five-year plans.

It would be possible to continue similar examples. Their reason is common. On this one hand, this is the weakness of the technological design and pilot production base and, on the other, the inadequate assistance on the part of production workers. The republic Intensification Comprehensive Program, which was formulated and approved by the Belorussian CP Central Committee, will help to eliminate the dissociation. It is also necessary to disseminate and use more extensively the tried and new forms of the integration of science and production. Scientific production associations, for example, have shown themselves to advantage. Thus, the Scientific Production Association of Powder Metallurgy--an organization, which combines the elaboration of basic and applied problems, their design and technological interpretation, and, finally, pilot experimental and commercial production--is operating with great efficiency. At the Planar Scientific Production Association the most complex equipment is developed and assimilated in 1-1.5 years. In 10 years the performance of the equipment being produced has been increased by five- to sixfold, the precision has been increased by nearly threefold.

The establishment of engineering centers, as well as temporary creative collectives is also aimed at increasing the creative return of scientists and specialists. Sectorial scientific institutions and scientific research laboratories or laboratories of dual subordination, which are being established in the VUZ and academy system, are called upon to become more fruitful links in the "science-production" chain. It is very important to enhance the coordinating role of the Belorussian SSR Academy of Sciences and to ensure as a whole the coordinated activity of academic, VUZ, sectorial, and plant science. The elimination of work on minor themes and duplication will make it possible to free scientific personnel and material and financial resources and, hence, to create better conditions for the more complete revelation of the creative and intellectual potential which has been accumulated here.

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INVENTION, PATENT WORK OF BELORUSSIAN TECHNOLOGICAL INSTITUTE

Minsk NARODNOYE KHOZYAYSTVO BELORUSSII in Russian No 4, Apr 86 pp 9-11

[Article by N. Skripshik, chief of the Department for Invention and Patent Work of the Belorussian Technological Institute imeni S.M. Kirov: "The Creative Invention Work of a Higher Educational Institution"; first paragraph is NARODNOYE KHOZYAYSTVO BELORUSSII introduction]

[Text] At the 8 faculties of the Belorussian Technological Institute imeni S.M. Kirov more than 6,000 future process engineers and mechanical engineers are being trained for forestry, the timber, wood processing, pulp and paper, microbiological, and chemical industries, and the construction materials industry. At the institute there are 11 scientific research laboratories--5 problem and 6 sectorial. Annually more than 160 themes with an amount of scientific research, which exceeds 3.5 million rubles, including more than 100 economic contractual themes, are fulfilled in accordance with the thematic plan of scientific research work. Much is being done at the Belorussian Technological Institute for the teaching to future specialists of the skills of creative technical work and scientific research work.

Of course, it is impossible to separate the process of instruction from the devising of highly efficient developments which the national economy needs. Under the conditions of a polytechnical higher educational institution this is a quite complex problem: the accomplishment of the tasks on comprehensive programs and the establishment of the corresponding pilot industrial works are complicated. Therefore, an efficient structure and a flexible system of the management of creative work are needed. The scientific research sector (NIS), in which there are the departments of the planning, organization, and introduction of the results of scientific research work, of scientific and technical information, of metrology and standardization, and of invention and patent work, is the basic coordinating link in this chain.

A large role has been assigned here to the Department for Invention and Patent Work. It carries out the procedural and organizational support of the measures of the rector's office on the increase of the efficiency of scientific research and studies the scientific research developments being carried out at the institute. The staff members of the department organize the protection of inventions, perform work on the assurance of patent .pa cleanness, and prepare recommendations for the patenting of inventions and the

sale of licenses.

At the department there is a patent collection in the basic directions of scientific research, which is constantly being enlarged. The necessary legal and standard documents has been assembled here. Consultant patent experts of the All-Union Society of Inventors and Efficiency Experts work at the institute as a voluntary service. They help to conduct patent research and to compile thematic collections on the themes of their subdivisions and help to draw up applications for inventions.

The patent information research system has become at the Belorussian Technological Institute an integral part of research and development at all stages. Owing to this all the themes that are capable of being protected are fulfilled at the level of inventions, while several are protected by a set of inventor's certificates. When evaluating the scientific teaching activity of the subdivisions of the institute the indicators on invention and patent work are in the forefront.

A plan and a program are drawn up for the introduction of scientific research works which contain inventions. Passports, which contain the necessary information on introduction, have been established for all the inventions of the higher educational institution. We send to the enterprises, which might need them, descriptions of the most effective inventions together with recommendations of the chairs or scientific research laboratories on the procedure of introduction and the anticipated economic impact. The contracts on creative cooperation with industrial enterprises have completed justified themselves. As a result in the past 15 years 3,047 applications for inventions were sent to the USSR State Committee for Inventions and Discoveries and 1,800 inventor's certificates were obtained. The economic impact came to 44 million rubles.

During the 11th Five-Year Plan such major inventions as a line for the processing of small-dimension timber, which is protected by six inventor's certificates, heat and mass exchange units, methods of the flotation of potassium-containing ores, logging machines, and others were devised and introduced in production. During this period 219 inventions were introduced with an economic impact of 20.3 million rubles. In all 38 patents were obtained from the United States, Great Britain, the FRG, Sweden, Japan, Italy, Canada, the CSSR, the GDR, and Bulgaria.

But there are serious difficulties in this matter. First, how is market research to be conducted quickly and correctly, if in Minsk there is no corresponding firm file? What is meant is detailed information on the activity of foreign firms which hold the leading position in the area of VUZ developments. Second, where is the corresponding advertisement to be prepared promptly? The sale of licenses depends at times on the quick settlement of these questions.

Creative efficiency work is also being successfully developed at the institute. Annually more than 100 applications for efficiency proposals, of which 60-70 are approved, are received. In 10 years 442 proposals concerning

training equipment--instruments, mockups, diagrams of technological processes--were used.

The Department for Invention and Patent Work prepares and handles all the technical documents on efficiency proposals. The prorectors of the institute examine and evaluate the proposals.

At the institute Honored Inventor of the Belorussian SSR Professor I.M. Plekhov, Honored Figure of Science and Technology Professor V.V. Pechkovskiy, and Professor N.A. Svidunovich developed and became famous.

During the past five-year plan more than 200 undergraduates became inventors and efficiency experts. Among our graduates there are the well-known inventors Docents V.F. Prudnikov and V.A. Simanovich; graduate students P.Ye. Voytekhovich and A.I. Gorost; senior scientific associate Ye.I. Grushova, and others. They have many valuable innovations to their credit.

In early 1983 the initiative "Industrial Checking and Introduction for Every Effective Development!" which was approved by the oblast and republic councils of the All-Union Society of Inventors and Efficiency Experts and was recommended to higher educational institutions, scientific research and planning and design organizations, scientific production associations, and industrial enterprises of the republic for universal dissemination, originated at the Belorussian Technological Institute. How is it being fulfilled?

Already at the stage of the inclusion of the themes in the plan the Department of Organization, Planning, and Introduction determines their effectiveness. The collectives of the Chair of Economics and the Organization of Production and the Department for Invention and Patent Work and the council of the All-Union Society of Inventors and Efficiency Experts of the institute actively help it. A calculation of the anticipate technical and economic impact is made for each theme which is proposed by the faculties for inclusion in the thematic plan. If the themes are included in economic contracts, such calculations are made jointly with the economic services of the interested enterprises. We define more precisely the effectiveness of developments after their completion and draw a conclusion on whom it is possible to offer it for use. The calculations, which are drawn up in the form of the corresponding document, are an integral part of the assignment on the theme.

The determination of the significance of developments for use in the national economy does not conclude with just the calculation of the effectiveness. The problem councils of the institute discuss each of them, while if this is a contact, the technical councils of production associations, organizations, and enterprises should voice their opinion.

Specialists of industrial enterprises are invited to conferences, meetings, and other measures on scientific research questions at the institute. Here they receive information on the innovations, which have been developed at the Belorussian Technological Institute, and participate in the analysis and evaluation of the obtained results. The benefit from this is great: in the past 2 years alone the institute has received more than 200 requests on the introduction of its developments.

The "inventory" of all the devised inventions was an important measure. With the assistance of the reference information service of the All-Union Scientific Research Institute of Patent Information (VNIIPI) it was established that 40 percent of the inventions devised at the Belorussian Technological Institute are being successfully used by industrial enterprises or have been embodied in experimental models. Here the contracts on the transfer of scientific and technical achievements have completely justified themselves. More than 70 inventions, which yielded an economic impact of 3 million rubles, were used in accordance with such contracts.

But the problems in the interrelations of the institute with production still remain. It happens that in spite of the obvious effectiveness of a development, it is not introduced for a long time. We believe: if the higher educational institution seeks at an industrial enterprise an object for the use of its scientific potential, economic managers should meet these aspirations half way. Interest should be mutual.

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KOLMOGOROV ON STANDARDIZATION, PRODUCT QUALITY CONTROL

Moscow STANDARTY I KACHESTVO in Russian No 4, Apr 86 pp 3-8

[Article by Chairman of the USSR State Committee for Standards Doctor of Technical Sciences G.D. Kolmogorov: "Go Farther, Achieve More"]

[Text] The 27th CPSU Congress, which will hold a special place in history as an event of world significance, which specified the strategy and pace of the advance of our homeland, toward a qualitatively new state of Soviet socialist society, completed its work on 6 March 1986.

In the Policy Report of the CPSU Central Committee, which General Secretary of the CPSU Central Committee M.S. Gorbachev delivered, a comprehensive analysis of the state of Soviet society and of its successes and difficulties was given, an imposing program of the creative activity of the party and people was developed, and the conception of the acceleration of the socioeconomic development of the country was thoroughly substantiated.

From the rostrum of the 27th congress our party again declared its aspiration to save mankind from the threat of nuclear war, to radically improve the international situation, and to provide the nations of the planet with reliable security.

The congress discussed and adopted the new version of the CPSU Program and the changes in the Party By-Laws and approved the Basic Directions of USSR Economic and Social Development for 1986-1990 and the Period to 2000--documents which are of enormous importance for the party and people and for all the units of the national economy.

Summarizing the development of the country, the congress noted that in the quarter century since the adoption of the 3d CPSU Program the Soviet Union made impressive gains. The fixed production capital of the national economy increased by sevenfold, the national income increased by fourfold. The real per capita income increased during the same period by 2.6-fold, while public consumption funds increased by fivefold.

Having evaluated the path covered by the country and its economic, social, and cultural achievements, the congress posed the task to overcome as quickly as possible the negative phenomena in the social and economic development of

society and to embark on the path of accelerating all the political, social, and economic processes of our life.

A sharp turn toward the intensification of production and the increase of product quality and efficiency is specified by the Basic Directions of Economic and Social Development. By 2000 the national income should increase by nearly twofold, with the doubling of the production potential, labor productivity should increase by 2.3- to 2.5-fold with a sharp decrease of the power-output and materials-output ratios. The strategic policy of the party is aimed at achieving a transition to an economy of the greatest organization and efficiency with comprehensively developed productive forces, mature socialist production relations, and an adjusted economic mechanism.

The congress specified that the main means of accomplishing these tasks are scientific and technical progress and the implementation of major comprehensive programs, which specify the dynamic development of the sectors which ensure a rapid economic return and the solution of urgent social problems.

Today It Is Becoming Vitally Important Not Only to Do More, But, What Is the Main Thing, to Do It Better

Having outlined the strategy of profound changes in the national economy, the party made the appeal to use for its implementation all the reserves of economic growth. In the Policy Report of the CPSU Central Committee product quality was named as "an immediate and major reserve."

The congress posed the task to increase by twofold during the 12th Five-Year Plan the output of products of the highest category and to ensure the sharp increase of the reliability, durability, and economy of all the items being produced.

It is a question of accomplishing a task of enormous economic and political significance, which is of fundamental importance for the development of the economy at the present stage. High quality is an indicator of scientific and technical progress, a characteristic of production and labor discipline, a source of the saving of manpower and material resources, and a means of satisfying the increasing needs of the Soviet people. High quality is a question of the competitive ability of Soviet products on the world market and one of the guarantees of the gaining of time in the economic competition with capitalism. It is quite clear that the further simple increase of the scale of production without the assurance of high product quality will substantially check the practical steps toward the increase of its efficiency, which have been outlined by the party and state. The task of increasing product quality should become the business of every Soviet individual.

Enormous responsibility is being placed on ministries and departments, associations and enterprises. All their activity on the development of production and its renovation and retooling should be accompanied without fail by the rapid introduction of advanced scientific and technical achievements in the development and production of items that are being newly devised, by the

rapid updating of their range, and by the organization of the output of products of a qualitatively new level.

"We can no longer tolerate the fact," it was stated in the Policy Report of the CPSU Central Committee, "that the workers of enterprises, which produce defective output, live without particular worries, while receiving in full the wage, bonuses, and other benefits." It is advisable, it is stated further, to link the amount of the wage fund of enterprises with the revenues from the sale of their products. This will help to eliminate the production and delivery of unnecessary, low-quality items.

A special role in the solution of the problem of quality is being assigned to the system of standardization. It is required of the State Committee for Standards to head the organization of the entire set of operations on the pursuit of state policy in matters of product quality control.

The Basic Directions of Economic and Social Development of the Country posed the tasks:

--to complete for the most part the introduction of comprehensive systems of quality control;

--to speed up the revision of standards and specifications for products, orienting them toward the highest world achievements;

--to improve the metrological service of the national economy;

--to increase the level of work on the certification of industrial products so that an objective evaluation of product quality would be ensured;

--to develop on the basis of promising scientific and technical achievements the classification of technologies by types and to intensify the sectorial and intersectorial unification of machines, assemblies, and parts.

The party requires of the State Committee for Standards and other control and law enforcement organs to erect a reliable barrier to the output of low-quality products, to use for this all the force of material and administrative influence and our laws, and to create an atmosphere of the inevitability of punishment for deviations from the requirements of state standards and other regulations. At the same time all types of moral and material stimuli should be put to use.

Understanding the full degree of responsibility for the solution of the problem of quality, we should analyze everything that was done in previous years, evaluate achievements according to their worth, reveal the shortcomings, and outline the strategy and tactics of systematic and purposeful work on the assurance of product quality.

Use More Completely the Experience and Achievements of the Past

By the end of the 11th Five-Year Plan a significant reserve, on the basis of which it is possible to devise a program of further work, had been prepared in the country.

The party Central Committee and the government adopted a number of most important decisions, which establish the procedure of giving labor collectives incentives for the output of products of the highest quality category and were aimed at the improvement of the remuneration and stimulation of the labor of designers, process engineers, foremen, and chiefs of sections and shops and the development of an economic mechanism which makes the output of obsolete products unprofitable for enterprises.

The updating of legislation in the area of standardization and metrology for the most part has been completed and, in essence, a set of legislative acts, the most important of which have been included in the USSR Legal Code, has been developed. Much has been done for the increase of the role of standards in the improvement of product quality.

In 1985 the first state standards of general technical requirements with long-term indicators were formulated and approved for the first time, 180 standards, which specify the list of basic indicators of quality for groups of similar products, were also approved.

During the years of the 11th Five-Year Plan the very important transition to the goal program method of work was made. By the end of 1985 more than 100 programs of complete standardization had been formulated, of them the approval of all the standard technical specifications was completed for 40 programs. The programs encompass, first of all, such priority directions as the development of machine building, the increase of the efficiency of the use of fuel and energy resources, the development of consumer goods production, and others. It is important that the programs of complete standardization are now being included as a fundamental component in the all-union scientific and technical comprehensive goal programs which specify the development of the most important sectors of industry.

The influence of the new Procedure of the Certification of Products With Respect To Quality Categories became appreciable. By 1 January 1986 more than 18,000 items had been certified in accordance with the new procedure. In all more than 28,000 descriptions of products of the highest quality category, the volume of which in the total production volume increased in a year from 15.5 to 16.3 percent, were produced in the country.

Changes occurred in the practice of state inspection. The new forms and methods of establishing effective barriers to violations of the requirements of standards and to the output of low-quality products found application here. Now all the stages of the life cycle of a product are encompassed by state inspection. Here the main attention has been focused on the checks of large enterprises, which determine the economic potential of the country, and on products which are of the greatest national economic importance. At a number

of enterprises acceptance is carried out by representatives of the State Committee for Standards.

During the years of the 11th Five-Year Plan definite gains in the further increase of the technical level and quality of the output being produced were achieved in the sectors of industry.

About 900 descriptions of new highly efficient and economical machines, equipment, and means of mechanization and control were assimilated by production. More than 250 types of obsolete equipment were removed from production. More than 40 percent of the machines and equipment of 11 machine building industries are produced with the State Emblem of Quality, the reliability (mean time between failures) and other technical indicators of the most important instruments of the monitoring and regulation of technological processes and electrical measuring instruments were increased by 1.5- to 2-fold.

The approval of new standards and the revision and updating of the prevailing ones contributed to the introduction of new advanced equipment.

Comprehensive systems of product quality control also played a considerable role. Wherever their introduction has been approached creatively, the share of items of the highest quality category is significant and the losses from defective output decrease systematically. In each economic region there are leading enterprises which persistently produce a large share of products only of the highest quality category.

However, as was pointed out at the 27th CPSU Congress, the existing level of quality of many items does not satisfy the requirements of today and the needs of the national economy and the Soviet people. The production by enterprises of obsolete low-quality products moderates the pace of scientific and technical progress, decreases production efficiency, and hinders the development of foreign and domestic trade.

The imperfection of components, the violation of the technology, poor technical control, and the low quality of materials entail large material losses of raw materials, materials, energy, and labor. The fact that poorly made components get to the consumer upsets the smoothness of production, the expenditures on the operational development of machines and, subsequently, maintenance and repair increase. Due to breakdowns and low reliability the annual expenditures on the repair of machines and equipment come to a significant amount, here millions of tons of metal are consumed, a large number of production workers are engaged in repair operations. In all 10 percent and more of the plant production capacities are diverted for the production of spare parts.

The needs of machine building and metal working for effective metal products are still not being completely met. The structure of domestic rolled stock requires further improvement. The quality of individual types of sheet and structural shapes does not satisfy present requirements.

The production of low-quality products is continuing at many enterprises of the USSR Ministry of Light Industry. Nearly 70 percent of the checked enterprises of this ministry produce in significant volumes products with the violation of the requirements of standard technical specifications, which do not correspond to the reference models, with numerous production defects. Many types of goods, as before, do not meet the increased demands of the population and lag behind the best foreign analogs in appearance. The failure to observe the requirements of state standards and specifications is one of the main causes of low product quality.

It should be frankly stated that both the standards themselves and especially the specifications in a number of instances contain indicators, which far from satisfy the requirements of today and are lower than the indicators established in international standards and standards of the industrially developed countries.

In 1985 the State Committee for Standards did not approve and returned to ministries for modification more than 20 percent of the drafts of state standards and rejected the registration of more than one-third of the sectorial standards and specifications due to their low quality.

The Work on Standardization to the Level of the New Requirements

The most important task of the State Committee for Standards, ministries, and departments is, first, to ensure during the 12th Five-Year Plan the approval of standards and specifications with requirements, which are oriented toward the highest world achievements, and, second, to ensure their quickest introduction in designing, production, and use.

Following the Basic Directions of Economic and Social Development, it is necessary:

--to complete the elaboration and approval of state standards of general technical requirements (OTT) with long-range indicators for the most important types of products and to ensure the elaboration, approval, and introduction during the current five-year plan of the indicated standards for all groups of similar products;

--to bring the collection of state and sectorial standard technical specifications in line with the long-range requirements of the standards of general technical requirements for groups of similar products;

—to create in the State Committee for Standards an information file of data, in which the indicators of the standards of general technical requirements for groups of similar products, including those which are of the greatest national economic importance, and indicators of the best foreign analogs are to be included;

--to achieve the early revision of the standards for raw materials and materials for the purpose of eliminating from them low indicators of the mechanical and chemical properties.

The fulfillment of the differentiated requirements of the standards with long-range indicators and the timely inclusion of these indicators in the standard technical specifications for specific types of products should actively contribute to the development and delivery to the works of new advanced equipment and to the removal from production of obsolete equipment.

In 1986 it is necessary at the main and base organizations for standardization to organize the performance of special serious scientific research work on the determination of the prospects of the development of groups of similar products for the purpose of ensuring the most complete consideration of the scientifically and economically sound demands on their technical level and quality.

The assignments on the elaboration of standards with long-range indicators should be included in the plans of development of sectors and should specify the directions and stages of the work of large collectives of designers, process engineers, and specialists of industry.

The close coordination of this work with the programs of complete standardization, which ensure the appropriate quality of raw materials, materials, and components, is a necessary condition of the effectiveness of long-range standardization.

It is also very important that for each indicator, which has been included in the standards of general technical requirements, methods of testing for the purpose of their objective evaluation would be developed.

International standardization, which affords extensive opportunities for the use of advanced foreign know-how and the mutually advantageous exchange of scientific and technical achievements, is playing a large role in the increase of the technical level and quality of products.

Active participation in the formulation of international standards and their maximum and efficient use when formulating national standard technical specifications are today one of the mandatory conditions of the radical increase of the quality of domestic products and the assurance of the competitive ability of Soviet goods on the world market.

However, these opportunities are being used far from completely. On the average only about half of the international standards--and today there are more than 7,000 of them--have been used when formulating domestic standard technical specifications. The participation of ministries and departments in the work of the technical organs of the International Organization for Standardization and the International Electrotechnical Commission does not meet the high demands, which the party and government are making on the increase of the effectiveness of international scientific and technical relations.

The task on the radical increase of product quality, which was posed by the party and government, requires a fundamentally new approach to the work on standardization within CEMA. First of all, it is necessary in the shortest possible time to bring the indicators and requirements of the prevailing CEMA

standards in line with the world level and to increase the demands on the making of a scientific and technical appraisal of the drafts of CEMA standards. The center of gravity in the planning of the elaboration of CEMA standards should be shifted to types of products, which are being newly assimilated.

Ministries and departments need to take immediate steps for the radical increase of the level of work on standardization within CEMA, to implement in good time measures on the standardization and metrological support of the problems of the Comprehensive Program of Scientific and Technical Progress of the CEMA Member Countries to 2000, and to take a specific part in the evaluation of contracts and agreements on the subject of the assurance of the conformity of reciprocally delivered products to the requirements of the CEMA standards and the best national standards of the CEMA member countries.

The problem of increasing the reliability of items is one of the most important aspects of the problem of quality, and especially in connection with the extensive introduction of automation and electronic equipment, flexible machine systems and robotics. Its successful solution promises a significant national economic impact.

It is well known that the expenditures on the assurance of reliability during designing are one-tenth as great as the expenditures on the elimination of the causes of breakdowns during the process of operation. Therefore, the basic emphasis in the solution of the problem of reliability should be placed on the development of items and the technology during designing and production. Unfortunately, today in the practice of the majority of design organizations the evaluation of the reliability of items and their development with respect to the corresponding parameters take place only after the organization of series production or, at best, after the production of the prototype, when factual information begins to be received from the sites of operation or from the testing grounds.

Much work on the establishment of order in the technical specifications, which regulate the demands on reliability, lies ahead. Many imperfect sectorial specifications, which contradict the requirements of state standards, are still in effect, there is also no order in the state standards for the regulations and methods of testing and the monitoring of the norms of reliability. The coordination of the physical methods of tests for reliability with the statistical probabilistic methods of its determination is necessary.

The main thing now is to increase the specific demands on the reliability of machines, units, and systems of machines, to ensure these demands in operation, and to organize the strict, constant monitoring of the quality of the materials, components, and technological processes, which determine the reliability.

Until recently the process of developing standardization took place in the direction of the broadening of the coverage by state standards of various types of products and aspects of production activity. This process was, undoubtedly, necessary. However, now in connection with the improvement of

the economic mechanism and the broadening of the rights and responsibility of ministries, associations, and enterprises the need for some regulation of the activity on standardization has appeared.

The approval of the new version of the standards of the State System of Standardization was the first step in this direction. It is necessary to ensure the quickest bringing of the sectorial specifications in line with the new provisions of the system and to rescind as quickly as possible all the instructions and statutes, which have become obsolete and hinder work.

The second important step is the improvement of the procedure of formulating and coordinating technical specifications in case of the development and delivery to the works of new (modernized) products of machine building.

In conformity with the requirement of the times the State Committee for Standards and the sectors of industry have to perform in the shortest possible time very much work in the direction of the drastic shortening of the time and the simplification of the elaboration and coordination of standard technical, design, technological, operating, and repair documents and to revise the sets of organizational methods standards and, first of all, the SRPP, the Unified System of Design Documentation, the Unified System of the Technological Preparation of Production, the Unified System of Technological Documentation, the GSI, and others.

The updated systems of organizational methods standards should contain the most necessary minimum of basic regulations and statutes, which simplify the procedures of the design and technological preparation of production, and at the same time should ensure the formalization of all routine operations in order to transfer a large portion of them to computers. This will make it possible to free an enormous creative potential of designers, process engineers, and production organizers.

Ensure Efficient Product Quality Control in Production

It is envisaged by the Basic Directions of Economic and Social Development to complete for the most part during the 12th Five-Year Plan the introduction of comprehensive systems of product quality control (KS UKP), which are a permanent comprehensive mechanism which links together the organizational technical, economic, and social levers of management.

It is well known that today more than 30,000 industrial enterprises have registered the introduction of comprehensive systems of product quality control. However, the comprehensive system of product quality control at the level of the enterprise is only the first step toward the mastering of advanced methods of product quality control. Experience shows that it is far from always possible to ensure high and stable quality only by the efforts of the enterprise, even when the system is functioning at it, because scientific research institutes, design bureaus, and supplier and user enterprises remain outside the sphere of its influence.

Precisely for this reason the principles of comprehensive product quality control in recent years have been introduced at higher levels of management--

in sectors and regions. Today sectorial systems are being developed in 33 USSR ministries and departments; more than 35 republic ministries have registered their own systems.

The effectiveness of the measures on product quality control, which are being implemented within the regional product quality control systems in Leningrad, the Latvian SSR, Dnepropetrovsk, Sumy, Tula, and Rovno oblasts, and many other regions, should be noted.

Now in light of the decisions of the 27tn congress, which noted that the strengthening of the territorial approach to planning and management is an essential aspect of the reform under way, this process should undergo the most extensive development.

In past years much work was performed on the scientific and organizational support of the development and introduction of systems. However, serious shortcomings exist in the practice of this work. Suffice it to say that of the number of enterprises, which have introduced comprehensive systems of product quality control, only two-thirds produce products of the highest quality category.

The State Committee for Standards has been forced to impose sanctions against the enterprises which have not been able to ensure the efficient functioning of the systems. Thus, in accordance with the results of a state inspection the certificates of introduction of comprehensive systems of product quality control at the Rostov Krasnyy moryak Ship Repair Yard, the Metallist Production Association of the RSFSR Ministry of Local Industry, the Chernogorsk Worsted and Felt Production Association of the RSFSR Ministry of the Textile Industry, and others were annulled.

In light of the decisions of the 27th CPSU Congress the formulation and implementation of the most important component of comprehensive systems of product quality control of so-called Quality programs in sectors of industry, regions, associations, and enterprises are of particular importance.

These programs should envisage the fulfillment of directive assignments on the increase of the share of products of the highest quality category and should contain assignments, which are differentiated in time, on the quickest achievement of the world level of specific types of products and the timely removal from production of obsolete items, as well as a set of measures on the standard technical and metrological support of quality at all the stages of the life cycle of products. The Quality programs should become one of the most effective levers of state product quality control.

The task is for Quality programs to be formulated in 1986 in all sectors of industry, associations, and enterprises and for similar work to be launched in the union republics, krays and oblasts, large cities, and industrial centers.

The providing of procedural assistance in the formulation of these programs and their examination in the State Committee for Standards and republic administrations and centers of standardization and metrology are the immediate

duty of the State Committee for Standards and its scientific research institutes and territorial organs.

Technical Control and State Inspection

Under the new conditions, when it is becoming unprofitable for enterprises to produce poor products, the technical control and metrological support of production are assuming quite special importance.

Both the experience of our industry and the practical experience of the work of leading firms abroad show that for the assurance of the output of high-quality products it is necessary to change the attitude toward technical control. It should be "built into" the technological process, moreover, for automated works this should be achieved literally. The anticipation of the possibility of defective output at all stages of the production process, starting with incoming control, should become the main task of advanced technology and accordingly technical control. Advanced measuring equipment and standard test methods should become the material base of such control.

Such an approach to the organization of technical control will eliminate the problem of the subordination of the technical control division, which has already become "perpetual." This subdivision will become an equal participant in the production process, and not the main "rejecter" of defective output.

The decisive turn of the national economy toward the radical improvement of the quality of the output being produced is impossible without the tightening up of state discipline and the establishment of order in the observance of the standards, the increase of personal liability for the output of poor quality products, and decisive steps on the activation of state supervision of standards and means of measurements.

Much has been done in the area of state supervision, but today it should be noted with all responsibility that the taken steps have not been able to ensure a drastic change for the better in this matter. At many enterprises of various sectors of industry they continue to produce poor quality items, systematically violate the requirements of standards and specifications, and for a long time do not update the products.

Far from always and not all the territorial organs of the State Committee for Standards exercise fully the extensive rights granted to them in the application of measures of influence and economic sanctions, which are envisaged by legislation, against those to blame for the output of poor quality products. This also applies to state supervision of the quality of the products which have been assigned to the highest category.

At present the significant increase of the amount of work in the area of state supervision of product quality is the basic task of the territorial organs. This supervision should become permanent, all-encompassing, and qualified and should ensure in the country an atmosphere of the inevitability of punishment for any violations of state standards and metrological regulations.

During the 12th Five-Year Plan the new form of state product quality control through representations of the State Committee for Standards at enterprises will be of great importance. Some experience of such work has already been gained. It attests that at the enterprises, to which representatives of the State Committee for Standards have been appointed, the technical control division operates more efficiently, technological discipline has been tightened up, and the responsibility of the immediate performers has been increased.

In 1986 representations will be organized at all the enterprises which produce the most important machine building products.

Improve the Systems of the Evaluation of Quality

In the Basic Directions of Economic and Social Development the task is posed to increase the level of work on the certification of industrial products so that an objective evaluation of product quality would be ensured.

In spite of some positive results of the introduction during the past five-year plan of the new Procedure of Certification With Respect to Two Quality Categories, in practice violations of this procedure are occurring, unscrupulousness is being displayed, analogs are being selected in an unobjective manner, and state certification commissions are being formed improperly.

Many items, which were submitted by ministries for the highest category, after examination in the State Committee for Standards are awarded at best only the first quality category.

In 1985 about 3,000 items were deprived of the State Emblem of Quality.

For the fulfillment of the decisions of the 27th CPSU Congress on the increase of the level of work on the certification of products the ministries need to increase for both the producers and, to a considerable degree, the users of the products the responsibility of their representatives in state certification commissions, as well as to increase the influence on the objectivity of the evaluation of the technical level and quality of products on the part of sectorial scientific research institutes.

The State Committee for Standards, in turn, should tighten up the monitoring and increase the level of supervision of this work in the country in order to preclude the possibility of an unobjective evaluation and the output of certified products of improper quality.

In speaking about the problem of quality, it is impossible not to say that the scale of the posed task requires the establishment of a permanent automated system of the information support of the work on product quality control in order to provide the necessary, reliable, and complete information on the achieved and predicted level of the domestic product and its foreign analogs.

This system in the end should include all the banks of factual data on product quality and ensure their interconnection at the level of computer media.

The first section of this system at the level of organizations of the State Committee for Standards should begin to operate already this year.

The Decisive Factor of All Changes Is People

An indispensable condition of the successful campaign for the increase of product quality is the extensive, active, and creative participation of collectives of workers and the scientific and technical community in the accomplishment of the organizational, technical, and economic tasks that are connected with this. In any labor collective very much depends on the mood and consciousness of the people, their skills and unity.

This makes special demands on the systems of the training and improvement of the skills of personnel and on the work of information and propaganda services in the area of standardization and quality control.

The task of establishing a unified system of continuous education, of which the training of specialists in quality and standardization should become an integral part, is posed in the Policy Report of the CPSU Central Committee. It is necessary to use all the forms and methods of instruction for personnel of all levels from the worker to the manager of the enterprise.

Scientific and technical societies, the All-Union Society of Inventors and Efficiency Experts, and houses and offices of quality can and should play a large role in the increase of product quality. The task of the institutes of the State Committee for Standards is to provide them with the necessary procedural and educational materials and skilled lecturers and consultants. The education and skills of each worker should meet the requirements of modern production.

Such are the basic directions of work, which follow from the decisions of the 27th party congress.

In conclusion it should be added that the atmosphere of great demandingness and adherence to principles, in which the congress took place, the Policy Report, and the decisions of the congress give us clear guidelines for the 12th Five-Year Plan and up to the end of the 20th century.

The immediate task is to bring the essence and spirit of the congress decisions to each worker and to turn these decisions into specific results of our activity.

It should always be remembered that standards are references for production, and the work of millions of people depends on the degree of their elaboration and clarity.

Our task is, by using to the utmost all the possibilities of standardization, product certification, and state supervision, to accomplish the task posed by

the 27th congress--to ensure the highest world level of the products which are produced at enterprises of the Soviet Union.

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STANDARDS OF SYSTEM OF PRODUCT QUALITY INDICATORS

Moscow STANDARTY I KACHESTVO in Russian No 4, Apr 86 pp 48-49

[Article by Candidate of Technical Sciences V.N. Fomin, the All-Union Scientific Research Institute of Standardization, under the rubric "The Evaluation and Control of Quality": "The Standards of the System of Product Quality Indicators and Their Role in the Accomplishment of the Task of Accelerating Scientific and Technical Progress"]

[Text] In the accomplishment of the tasks of increasing product quality, which are posed in the Basic Directions of USSR Economic and Social Development for 1986-1990 and the Period to 2000, two directions, the first of which is connected with the increase of the technical level and quality of new products, while the second is connected with the increase of the technical level and quality of the products being produced, have appeared.

Standards, which establish the long-range demands on groups of similar products, are the basis for the first direction.

The main and base organizations for standardization in practically all sectors of industry have begun the elaboration of such standards. Working Document 50-435-83 "Methods Instructions. The Procedure of the Elaboration of State Standards With Long-Range Demands Within the Scientific Research Work on the Determination of the Prospects of the Development of Groups of Similar Products," which was approved by the State Committee for Science and Technology and the State Committee for Standards, is the standard document which supports this work. The standards with long-range demands refer to a type of standards of general technical requirements (GOST OTT).

The GOST OTT are elaborated for groups of similar products, the list of which is approved by the State Committee for Standards and the State Committee for Science and Technology upon the representation of USSR ministries and departments [1]. The value of the basic indicators in the GOST OTT is established as two stages of the technical level and quality of a product:

—the first is the demands on the best product which has been assimilated by production;

--the second is the demands on a product which corresponds to the long-range world level.

The demands of the second stage of the GOST OTT are included in the technical assignments for the development of a new (modernized) product. The demands on a specific product (models, brands, types), which ensure the fulfillment of the GOST OTT, are specified by the standards and specifications for this product.

The term of effect of the demands of each stage should be established on the basis of the need for the systematic updating of the product for the purpose of ensuring its conformity to the highest world level. In particular, for machine building items the elaboration of differentiated standards of the time of their updating (modernization) is envisaged by the decree of the CPSU Central Committee and the USSR Council of Ministers "On Measures on the Acceleration of Scientific and Technical Progress in the National Economy."

Upon expiration of the term of effect the first stage of the GOST OTT is replaced by the second stage. The new second stage is approved in accordance with the results of the newly performed scientific research work on the determination of the prospects of development of a group of similar products. The standard technical specifications for a specific product, which is included in the group, should be brought in line with the demands of the new first stage of the GOST OTT and should be put into effect at the same time that this stage is put into effect.

The programs of the increase of product quality [2-4] are the basis of the second direction.

The existence of specific demands is common to the GOST OTT with long-range requirements and the programs of the increase of quality. In both cases it is a question of the basic indicators of quality.

The basic indicators are established in the standards of the system of product quality indicators (SPKP). The method of determining these indicators is contained in Working Document 50-64-84 "Method Instructions on the Elaboration of State Standards Which Establish the List of Indicators of Quality of Groups of Similar Products." This document is called upon to ensure the unity of the content and procedure of the elaboration of standards which establish the list of indicators of quality of groups of similar products with the singling out of the basic indicators.

The GOST SPKP, just as the GOST OTT, are elaborated for groups of similar products in conformity with the list. The basic areas of application of the list of indicators of quality are: the technical assignments for scientific research work on the determination of the prospects of the development of a group of similar products; the GOST OTT; standards which are being elaborated and revised (except the GOST OTT), the technical assignments (TZ) for experimental design work, specifications (TU), and cards of the technical level and quality of products (KU).

There are assigned to the basic indicators of the quality of a group of similar products: the groups of indicators of the purpose (functional indicators and indicators of the technical efficiency, design indicators, indicators of the composition and structure); the indicators of reliability (dependability, durability, keeping quality); the indicators of the economical use of raw materials, materials, fuel, energy, and manpower resources; the indicators which characterize the limitations of harmful effects (ergonomic and ecological indicators, indicators of safety); the indicators of standardization and unification.

The list of basic indicators of quality for groups of similar products is established by two methods of the direct formation by experts of the list of basic indicators or the consequent formation by experts of the list of basic indicators with the use of tables of applicability.

The first method is used in case of the lack of sufficiently complete information on the initial list of indicators of product quality. It consists in the fact that the experts, by using the information accumulated in the process of their own activity, directly set the basic indicators of quality for the group of similar products. Here it is desirable that a process engineer, a designer, and a specialist in the use (consumption) of the product would belong to the group of experts.

The decision of the expert commission is also the basis for the second method. However, the implementation of this method envisages several stages, including the determination of the initial list of indicators of the quality of the models (brands, types) of the product, which is included in the group of similar products, on the basis of the analysis of domestic standard technical specifications, CEMA standards, international standards, and standards of foreign countries for the product, the reports on scientific research work, industrial catalogs, prospectuses, patents and inventor's certificates, domestic and foreign scientific and technical periodicals, and other sources of information. Both the basic indicators, which are included in the GOST OTT, and the indicators, which are included in other documents, are established on the basis of the initial list.

What is understood by the basic indicators of quality?

In conformity with Working Document 50-64-84 the basic indicators of quality of groups of similar products are the indicators, which determine the national economic efficiency of the production and operation (use) of the product for its purpose, the most complete meeting of the needs of the national economy and the population of the country, defense and export needs and ensure: the increase of the reliability of the product; the decrease of the labor intensiveness in the production and the increase of the efficiency in the operation (use) of the product; the decrease of the specific consumption of raw materials, materials, fuel, and energy in the production of the product and its operation (use); the reduction of the specific expenditures on the development, production, and operation (use) of the product; the acceleration of the process of the development and assimilation of the production of the new (modernized) product by means of unification.

The list of basic indicators of quality of groups of similar products should ensure:

—the possibility of characterizing the prospects of development of the given group of similar products during the forecast period;

—the evaluation of the technical level and quality of the product;

—the development and introduction of new technical solutions;

—the possibility of comparing the technical level and quality of the product with foreign analogs.

For the fulfillment of the last demand, which is important for the comparative evaluation of the technical level and quality, it is recommended, in particular, to use the manual on the identification (description) of groups of similar products, the information on which is contained in the appendix to [1].

The basic indicators should be included in all types of standards for the product, as well as in the card of the technical level and quality.

The system of product quality indicators has been under development since 1967 and is a set of standards which established the list of indicators of quality for groupings of products. As of 1 January 1985, 136 state, 953 sectorial, and 13 republic standards belonged to the system of product quality indicators.

From the aforesaid it follows that the standards of the system of product quality indicators ensure the fulfillment of one of the basic stages of the evaluation of the technical level and quality of a product, which, in turn, is one of the steps of the assurance of the production by domestic industry of machines, equipment, instruments, materials, and other products, which conform in their technical and economic indicators to the highest world level. This stage consists in the establishment of a list of product quality indicators, in accordance with which the evaluation is made. Here the combination of the general demands, which are of an intersectorial nature, with the specific sectorial nature and peculiarities of specific types of products is ensured.

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SPECIFIC NATURE, STRUCTURE OF SCIENTIFIC ACTIVITY

Moscow OBSHCHESTVENNYYE NAUKI in Russian No 2, Mar-Apr 86 pp 107-124

[Article: "The Specific Nature and Structure of Scientific Activity"*; passages within slantlines published in italics]

[Text] As science is transformed into an immediate productive force, in scientific activity there are appearing more and more clearly, on the one hand, the differences from other types of production and nonproduction activity and, on the other, what, on the contrary, unites scientific activity with other types of activity (for example, inventing or technological, information or documentation activity, and so on).

Science as a special form of activity and a special social institution has a specific internal structure, between the components of which specific dynamic relations are maintained. The internal structure of science as the base and at the same time the result of cognitive activity finds its expression in the unique division of labor by specialties, types of research, functions being performed, and so on. The object and subject of research, as well as the combination of methods, which are characteristic of the corresponding research field, serve as factors which determine this division of labor and the organizational structures which are based on it. The latter, on the one hand, depend on the specific nature of science and, on the other, experience the intensive influence of external circumstances: the formed type of interconnection of science and society; social and political conditions; cultural historical traditions, and so forth. In this sense scientific societies, scientific institutions, scientific schools, the forms of management, and in general the organizational modi act as secondary elements of the structure of science, which are turned outside.

*A chapter by the same name from the collective monograph of scientists of the socialist countries, "Osnovy naukovedeniya" [The Principles of the Science of Science], Moscow, "Nauka", 1985, is published in abridged form. The book was published under the editorship of: N. Stefanov, P. Yakhiel (Bulgaria), J. Farkas (Hungary), G. Kroeber (the GDR), I. Malecki (Poland), S.R. Mikulinskiy (the USSR), director of the collective of authors, and R. Richta (1924-1983) (the CSSR). Candidate of Biological Sciences B.A. Starostin, senior scientific associate of the Institute of the History of Natural Science and Technology of the USSR Academy of Sciences, prepared the chapter.

The appearance of structured and relatively isolated scientific activity should be regarded as a historical process. It occurs in different fields of knowledge at different times.

Of fundamental importance from the standpoint of the historical development of scientific activity was its professionalization, which also had a most profound effect on the internal structure of scientific activity. In many cases such a trend finds its expression and shaping in the intensifying division of labor in science, that is, in the appearance of workers who are engaged professionally in the fulfillment of specific types of scientific activity.

The peculiarities of scientific activity are determined by the character of its social functions and by the nature of the social problems being solved by it, among which are the assurance of the increase of the productive forces of society, the elaboration and development of a scientific outlook, the control of social processes, their foreseeing (including the foreseeing of the growth of science itself), the purposeful influencing of the natural environment, and the optimum use of natural, demographic, and intellectual resources and so on. The problems, which are connected with the assurance of the reproduction of scientific activity itself and science as a social institution, constitute a special and very important class.

The conception of science as one of the forms of spiritual production, which was developed for the first time by K. Marx, serves as the necessary base for studies of scientific activity. For the interpretation of the specific nature and structure of scientific activity on the level of this conception it is necessary first of all to differentiate science from other forms of spiritual production (art, management activity, efficiency promotion and inventing activity).

Scientific activity is one of the types of general labor. In individual acts of the scientific activity of a scientist both the division of labor and cooperation with his contemporary colleagues and the universality of scientific labor (the use of the labor of predecessors) already find their expression. The continuous generation of new knowledge, which adequately reflects reality, and its inclusion in the already existing system of knowledge, which serves the understanding and transformation of reality, are an essential characteristic of science. Of course, the increase of the already available spiritual wealth is characteristic not only of science, but in general also of all spheres of spiritual production. However, research activity increases this wealth on the cognitive level, ensuring the conceptual interpretation of the phenomena of reality, which are being studied, on the basis of a continually developing conceptual system. "The concept (knowledge) in everyday life (in immediate phenomena) reveals the essence...such indeed is the /general course/ of all human knowledge (all science) in general." (Footnote 1) (V.I. Lenin, "Poln. sobr. soch." [Complete Works], Vol 29, p 298)

The objective knowledge of phenomena of reality acts as the most general of the specific distinctions of scientific activity, including its most abstract theoretical forms, for example, mathematical knowledge. Such features, which

are inseparable from science, as the systematic and rational nature of its methods and applications, the possibility and necessity of the successive transfer of scientific knowledge in the process of the education of scientists, the practical and philosophical importance of science, and the functioning of science as a form of social consciousness are associated with this specific distinction. The differences of a more particular nature, such as the regular use of experimental methods, computational methods, and so on or the need for the passing of the achieved results through the "filters" of the scientific community, of course, also touch on science as a whole, since they affect the nature of the interrelationship between its components.

Among the forms of the division of labor in science the division by specialties and fields of knowledge is one of the most essential and first of all conspicuous ones. This traditional type of division of labor left a profound mark on the entire organization of scientific activity (institutes, laboratories, and so on) and, undoubtedly, will be retained in the future and be developed by the formation of new scientific specialties. At the same time it is not the only one. In many fields of knowledge, where the transfer of knowledge and information from basic research to applied research and further to the sphere of development is occurring especially intensively, the triple or more fractional "vertical" division of labor inevitably accompanies this type. Moreover, the generation of knowledge and its use are closely connected. The use of available knowledge plays an important role. An extensive group of occupations and specialties, which are connected with the processing, storage, and distribution of scientific information, with the stimulation and development of scientific communications, with the transfer of knowledge to new sections of scientific production, with the popularization and spread of scientific knowledge, and so on, is isolated during the development of science (and especially rapidly at the stage of the scientific and technical revolution).

The specific nature of the division of labor in the field of science is also expressed in the fact that the distribution of the product of science proceeds in various directions. A portion of this product is consumed during the introduction of knowledge in physical production, the other scientific data do not always find industrial application, but are used in science itself. Moreover, the consumption of scientific knowledge has its specific nature: it can be used repeatedly, without losing its value in the least because of this.

Thus, the division of labor in modern science is a multidimensional phenomenon. Originating at a specific stage of the development of the social division of labor, science during its functioning becomes itself a factor of the further intensification of this division.

The division of labor in science is realized in the unity of the processes of differentiation and integration. Such forms of the differentiation of science as: the isolation of basic and applied research, as well as experimental design development; the division of humanities and natural science research, which, in turn, is permeated by the processes of differentiation and integration; the distinction of vast comprehensive projects (the development of space and the ocean, environmental protection), and so on, are accompanied

by professional specialization, which gives rise to newer and newer types and forms of activity of scientists.

The types of division of labor, which are inherent in each historical stage of the development of science, affect both the specific nature of scientific activity as a whole and all the levels of the structure of this activity. In case of the generation of knowledge the division of labor between the representatives of different disciplines and fields of knowledge and between the participants in comprehensive projects and programs comes to the forefront. The division of labor by methods and types of activity (theoretical, experimental, and so on) within common social institutions correlates with this.

The integrative trends, which in recent times have been traced more and more distinctly in the development of science, themselves act as a manifestation of one of the forms, one of the trends in the progressive division of labor. No matter what fundamentally new tasks arise for science (the protection of the habitat of man, the efficient use of the world ocean, urbanization, global problems of the present, and so on), they invariably require the formation of new types of specialists, new forms of activity, and, hence, also new types of the division of labor in science.

Science can be examined from different angles: as a system of knowledge, as a social institution, as a form of social consciousness. For the study of the objects, which are characterized by such a multidimensional nature, the distinction in them of the primary structural unit, or "nucleus," on which it would be possible to trace the laws of development of this object, assumes vital importance.

The distinction and analysis of the structural units of science are of /methodological/ importance: in a number of cases it is advisable to study such a complex phenomenon as science on a simpler object, the components of which in the basic or at least several essential traits reproduce the structure of science as a whole, are limited in their size, and are mutually comparable in their essential attributes.

The distinction of the structural units of science is also of /practical/ interest for the problems of the planning, forecasting, and management of science. The methods of solving these problems will be modified substantially depending on precisely which elements are singled out and for what purposes.

Finally, no empirical study can have as its object science as a whole. In this connection in the science of science the question of the choice of such a unit (or such units) of analysis, which would be, on the one hand, visible and compact enough so that its empirical study would become possible and, on the other, representative enough in order by means of it to establish the laws, which apply to science as a whole or to its sufficiently large subdivisions, is also arising.

Within the science of science different versions of the distinction of such units have been proposed: by institutions (higher educational institutions, scientific research institutes, clinics, and so on), by the results of

research, by types of publications; a breakdown by scientific disciplines or by phases of scientific research activity, by forms of the division of labor in science, by some types or others of the social organization of research activity (the scientific school, direction, "invisible colleges"). At the start of the empirical study of science (and this is quite natural) when defining the object of research as some sufficiently clearly limited and internally connected unit, an element in the structure of science the choice of one research method or another played a decisive role. Thus, the study of quotation networks gave the first unit, the analysis of groups of coauthors--the second, surveys, during which the group of authors, who interest the respondents of some group, was studied--the third, the study of the group of authors who are published in a given scientific journal--the fourth, the study of scientific reference works--the fifth. As a result a large number of objects ("the invisible college," the scientific community, the scientific school, the united scientific group, the scientific direction, and so on) were discovered.

Quite soon, however, it became clear that such a situation leads not only to terminological disagreement, but also to the fact that the data obtained by different researchers can prove to be incomparable. Such incomparability appears most pointedly in situations, when empirical results are enlisted for the checking of some theoretical assumptions and conceptions or others. It is clear, therefore, that the attempts at the theoretical comprehension and interpretation of the growing empirical material inevitably lead to the posing of the same question--about the structural units of science. But now this question appears in a different form--not from the standpoint of which units it is possible to obtain on the basis of the given method, but from the standpoint of what set of methods it is necessary to use (or it is even necessary to develop) for the empirical recording and study of some theoretically isolated structural unit.

All types of the structural division of science and kinds of organization of research, be it the stages of a still unformed discipline or interdisciplinary research, a research program, a scientific direction, a scientific specialty, and so forth, in one way or another correlate with the obtaining of new knowledge as the goal of science and, hence, with the classification, subdivision, and differentiation of this knowledge. Hence the possibility of describing these types and stages by their correlation with some initial structural unit, as which it is advisable to regard /the relatively integral research field/. By a research field as an actually functioning structural unit for specific studies of the science of science and scientometry we will understand precisely an integral field, which is characterized by the community of research aims and principles. This field, or structural unit, can be viewed from various angles. On the content level it acts directly as a set of studies, which are devoted to the given problems, or as a research program, regardless of whether it is a question of operations already being performed or operations which have mainly been planned; on the communication level--as a community; on the organizational level--as an institution (group of institutions) or plan.

Every scientist is a researcher in some specific field. And this field is for him a field of application of cognitive methods, the sphere of effect of

"formalized common sense," a directly perceivable and "open" object of the scientific community. This field is, thus, something that at least potentially reproduces in itself the basic traits of science as a whole. It is significant that given the present level of the progress and institutionalization of science the research field is without fail multidimensional, being shaped not only with respect to the subject, but also organizationally, psychologically, communicationally, and so on. At a specific level (namely at the level of the distinction of the structural nucleus of science) these aspects coincide and, for example, the research field as the subject of the interests of the scientist most clearly corresponds to: the collection of works, in which the content of the given field is set forth, as well as to the set of people, laboratories, or groups, which are studying it; the set of methods which are specific to the given field. One should not, however, forget the arbitrariness of such a one-to-one correspondence: the community of specialists in some field can be placed in such a correspondence with the content, organization, and structure of this field only for purposes which require the distinction of the structural units of science (for example, for the formation of a plan of the development of science, in case of the distribution of physical assets and manpower resources, and so on). In other instances the specific nature of the corresponding aspects comes to the forefront; but the nuclei, which are singled out in these aspects, also remain isomorphous as manifestations of the common (and as applied to the individual study, also for the group of scientists) structural unit--the research field.

From the standpoint of the analysis of the "nuclei" of science it is essential to distinguish among all the possible structural units of the /subject-content/ level of science the "minimal' unit or, in any case, a unit, which lends itself with difficulty to subdivision and at the same time would preserve in it the entire specific nature of the corresponding aspect. In this context the problem of distinguishing the str ctural unit of science approaches the task of /the classification of knowledge/ and its division. Such division inevitably leads to research fields, which form historically and to each of which a specific community of scientists clearly corresponds. This makes possible the use of both the content aspect of some research field and (in this case we already obtain the communication nucleus, which is quite clearly linked with the content nucleus) the scientific association which corresponds to this research field.

The sections of the research front, which in one period of time act as integral scientific fields, in another can prove to have broken down into a number of relatively independent formations. Thus, chemical physics, which formed during the first 30 years of the 20th century as a relatively cohesive field, in the middle of the century had already broken down into research fields, which study, accordingly, the structure of the electron shell of the atom, the quantum mechanical nature of valency, and so on. Similar, but more complex processes occur in case of the differentiation of research fields, which is accompanied by the integration by type of comprehensive projects and programs.

The existence of a scientific idea and the appearance of an effective method are two factors, the fundamental interaction of which leads to the formation

of a new viable research field (if we speak about the content aspect). Thus, in the work of L. Mullins (Footnote 2) (L. Mullins, "The Development of a Scientific Specialty," MINERVA, Vol 10, 1972, pp 51-82) this interaction is examined on the basis of the material of the formation, which occurred in the middle of the 1960's, of chronobiology as a "hybrid," but at the same time integral sphere of knowledge and research. On the one hand, the idea of the commonality of the regularities of daily, annual, and other biorhythms and, on the other, a special version of the statistical method, which is oriented toward the study of periodic phenomena at the cellular and molecular biological levels, were the basis.

Usually the method, which is involved in the devising of the research field, "serves" several such fields, each of which at the same time "is served" by several methods. As a result a unique matrix of scientific methods and research fields is created. This is one of the integration mechanisms of science. As to the organizational aspect of the research field, which is based on the functioning of the community corresponding to it, here it is necessary to reject the notion of the community, which forms in some field, as a purely disciplinary phenomenon. Interdisciplinary and multidisciplinary communities, which carry out theoretical and practical research in many directions which are interconnected by the unity of national economic tasks and aims at the understanding or transformation of a complex object, the integrity of which slips away from the researcher in case of the approach from the position of some one particular discipline, are entirely possible, while in the 20th century became widespread.

The organization after the pattern of large scientific programs, including international ones (the International Geophysical Year, the Project of the Upper Mantle of the Earth, the Hydrological Decade, various Antarctic and oceanographic programs, and so on), is becoming more and more characteristic of the present stage of development of science.

Not simply the coexistence or interaction of various research fields in one integrity as a "nucleus" of science (on the content level), but also their interpenetration, which in a number of instances can also give rise to new structural units of science, which are inherent in this level, are characteristic of a comprehensive project.

The structuring of science after the pattern of comprehensive projects on the content level signifies a new level of the complication and enrichment of the subject of research, but also leads, of course, to the change of the forms of the organization of science and the methods of communication. All these processes cannot but also affect the entire front of scientific research which has not been involved (if only indirectly) in new global and subglobal types of the integration of scientific activity. The units of this sort can be represented as an ensemble of structural units of the interfield type, which are expressed in the form of "research programs," each of which can cover a number of contacting fields, but can also be confined to one of two of them. The relations between research programs are far from always harmonious and mutually complementary: they can compete with each other, supplant each other, and so on. However, during the period of their existence such programs often act as integral and "minimal" ones, satisfying all the criteria of

structural units of science, and then can be regarded as such, at least on the communication and content levels.

The /organizational/ aspect of research fields and their groups finds structural expression in the same forms, in which the joint organizational nature of labor which is based on the cooperation of individuals is generally expressed. For the organizational "nuclei" of science the same kinds of forms of subdivisions (institutions, divisions, groups, and so forth) are distinguished, but the same relations of coordination and subordination, which are also typical of other types of human activity under specific sociohistorical conditions, are characteristic of these subdivisions. These nuclei differ both in their scale (from small groups to enormous scientific communities) and in other criteria--economic (the source of financing, the nature of the assimilation of capital), administrative structural (institutes, universities, industrial laboratories), social. and cultural historical.

Based on the classification by each such criterion and taking into account the attributes of the structural unit, it is possible to distinguish "minimal" collectives, which are comparable with respect to the criterion in accordance with which they were selected. These collectives, for example, groups of staff members within a scientific research institute (the primary scientific collective as a scientific group), instructors of the same university chair, and so forth, can be regarded as elementary nuclei, the uniting of which forms nuclei of the second and higher orders. Accordingly, the research field, which is attached to each collective, is also included as a part in the research field of a higher order, individual themes are included in group themes, the latter are included in plans or thematic lists of institutes, academies, and so on. The authors of many works on the science of science and questions of the organization of science in practice are guided by such an approach.

Structural units, which pertain to the sphere of /communication/ (the communication aspect), are also characteristic of science as a form of labor and the generation of knowledge. Congresses, conferences, as well as centers of information and documentation service, just as the major documents produced by these services, conferences, and so on (transactions of congresses, analytical surveys, and so on), serve as models of the nuclei of scientific activity which is being examined on this level. Are the criteria of minimality, comparability, and structural analogy with science as a whole actually applicable to these nuclei? It is possible to answer this question affirmatively. If a published document, being one of the stages of the act of communication, reproduces in itself such characteristics of scientific knowledge as reliability, objectivity, practical usefulness, and reproducibility and in so doing is comparable to other similar documents, we can regard it as one of the structural units of this aspect, a "nucleus" of the documentation level (if the latter is presented in written form) and a "cluster" of communications, its concentrated physical trace.

The compatibility of the labor of scientists is realized owing to communication. Here communication is not identical just to the exchange of scientific information. Many aspects of scientific communication go far beyond the field studied by information science. This applies, in particular,

to the economic, psychological, social, and several other problems of communication.

The implementation of scientific communications presumes as necessary conditions the lending of a specific number of addresses to scientific knowledge and an orientation in the "communication space"; the affording to the scientist of an opportunity to keep continuous track of the state of knowledge about the object being studied, "to be in the know" about this knowledge at the most advanced level; the development and improvement of the means of communication itself, which would enable researchers to cope efficiently with the continuously increasing sizes of information files. Thus, for the study of the communication aspects of scientific activity it makes sense to examine in sequence the phenomena which are connected with publications, their circulation, and their role in the work of the scientist; mechanisms, which ensure the efficiency of communication and its conformity to the level of knowledge, which has been achieved in the given research field, and to the created scientific potential; the tools of scientific communication and the assistance being given by it in immediate scientific activity.

Scientific communication can be regarded as an information process, and many phenomena on the level of communication find themselves a direct correspondence in information science. At the same time communication activity should not be reduced just to information activity, since in this case we will lose the specific nature of scientific communication as a more complex process, which pertains to a higher structural level as compared with purely information processes.

Communication begins from the moment when information has already been obtained. After this it undergoes the most complex creative processes of processing, analogies of which it is impossible to find in other, more stereotypic areas of the transmission and reproduction of information. It is impossible to eliminate from scientific communication the /social/ features, for the scientific report is something addressed to specific social individuals and directly serves the interests of physical and spiritual production.

The moral and legal aspects, which are connected with the desirability or undesirability of some scientific research and reports on it or others, with various kinds of moratoria, with collective and international efforts in the matter of the transfer of advanced technology, the results of basic research, and so on, in many respects are connected with the problems of scientific communication. Such forms of the organization of the information and contact of scientists, which contain an integral social and sociocultural component, as international and national congresses, conferences, symposiums, the printing of their materials, the dissemination of preprints, "invisible colleges," and so on are also specific to science and scientific communication. However, it is necessary to state that given all the ceaseless evolution of the forms and methods of scientific communications the collection of publications, first of all primary publications, remains the basis subject of the research of the science of science, which concerns scientific communications. We have in mind scientific monographs and journals, as well

as the collection, which originates in case of the processing of these primary publications as a result of translating, abstracting, and popularizing activity.

Under all conditions (regardless of its origin) the collection of publications should have such an important property as good organization or structurization. Within this collection it is nearly always possible, regardless of what research field it pertains to, to distinguish individual echelons which are at a different distance from the front line of research. (Footnote 3) (See in greater detail E.M. Mirskiy, "Mezhdistsiplinarnyye issledovaniya i distsiplinarnaya organizatsiya nauki" [Interdisciplinary Research and the Disciplinary Organization of Science], Moscow, 1980)

The main formal feature, in accordance with which individual echelons of publications are distinguished, is their "genre" peculiarities. Each type of scientific publication performs within the aggregate collection of publications quite specific functions. It is possible to represent approximately the general sequence of publication echelons in the following manner: 1) letters to the editor and short reports; 2) journal articles and publications of papers at scientific conferences; 3) confirming reports, surveys of a periodical (problem, analytical, and others), surveys of symposiums and conferences on the given research field over some period of time; 4) problem collections, monograph articles, individual and collective monographs; 5) textbooks, series of lectures, teaching aids, readers, popular scientific interpretations of the content of disciplines.

The content of the publication collection gives an idea of the present state of knowledge in the corresponding research field: on the level achieved at the given moment and the content of the integral representation of its subject (textbooks); on the state of the systematic examination of the most important problems (monographs); on the directions of the most intensive research efforts and on the approaches to each major problem (surveys); on the methods of the study and the obtained results (articles); on the origin of potential new research fields and on new alternatives in the given field itself, which are often controversial, but are combined with quite serious ones, so that it would be possible to mention them in the press (reports).

The content of the collection of publications makes it possible to get one's bearings in the research results, which have already been obtained and are liable to subsequent "consumption in production" in science. As to the interaction of scientists on the front line of research, where, strictly speaking, new results are also obtained, there contact only through publications in many cases proves to be insufficiently effective. Even in case of ideal information service the researcher has information only about what his colleagues were dealing with 3-4 years ago. In other words, if a scientist were to limit himself in the study of his research field only to published information, at every moment of time only a portion of the really existing and circulating (including in notes, in informal conversations, in manuscripts prepared for publication) information on the problem would be accessible to him. The size of this portion, according to some American estimates, comes to 66 percent, according to others--less than half

(47 percent). The differences depend, apparently, on the specific nature of the research fields.

It is possible to a significant degree to compensate for the shortcomings of efficiency, which are inherent in the system of scientific publications, by the increase of the efficiency of contacts and their selectivity. This makes it possible to keep contact all the time in the necessary direction, by intercepting questions which do not apply to the theme; it makes it possible to discuss no yet completely formed ideas and notions; it contributes to the rapid finding of analogies between the problems being discussed and the themes of other fields. Here the communication participants can organize themselves the process of contact and use the feedback mechanism, extending again and again the features of contact, which interest them; in addition, they obtain information on the content of the work being performed many months before its results are published.

The scientific school and the theoretical science symposium are the most important forms of the organization of stable contacts among scientists. At the scientific school young researchers jointly and under the supervision of the leader formulate its program, while maintaining close contact both with each other and (in particular) through the teacher with "the rest of the world." The theoretical science seminar is organized at the base of one of the most well-known centers for the given research field, while one or several leading specialists supervise its work. The seminar usually unites a large group of researchers, who participate in its work in order to obtain fresh information, as well as qualified criticism of their results. A unified program is optional for the seminar, it is rather a form of the regular prepublication generalization of preliminary research results. It is essential, especially for young researchers, that in the process of working at a seminar they have the opportunity to compare and evaluate the positions and approaches, which characterize the different schools in the given research field. Seminars, being one of the forms of the organization of scientific communication activity, at the same time also act as an important form of the training and reproduction of scientists.

Debates are a special aspect of scientific communication. It is well known that the history of science abounds in debates which are connected with factual, theoretical, and philosophical problems of science. Any innovations rarely get by without debates. The willingness to defend one's own conceptions by means of empirical and rational arguments acts in the development of science as an integral component of the stand of the scientist—the representative of the scientific community; in the process of the debate it is established precisely who with greater reason can claim the role of the "spokesman" of the community on the given question. The study of the forms of debate in the history of science clearly demonstrates the nature of the scientific community as a structural unit of science, as a system which is open, dynamic, saturated with contradictions, and socially determined.

An adjusted system of communications is conducive to the increase of the scientific potential. The weakness of information and communications, on the other hand, leads to unjustified duplication. As to the equipment of communication, within it one should distinguish integrated information

systems. They are sets of methods and means, which make it possible "in case of the one-time description, indexing, and reviewing of scientific documents and the conversion of the obtained data into computer-readable form to ensure the multidimensional processing of their data and their repeated use for the meeting of diverse information needs." (Footnote 4) (A.I. Mikhaylov, A.I. Chernyy, and R.S. Gilyarevskiy, "Nauchnyye kommunikatsii i informatika" [Scientific Communications and Information Science], Moscow, 1976, p 344) "Information banks," or "data banks," which in contrast to these systems do not carry out the analytical synthetic processing of sources, border on integrated information systems. Each of the banks is based on some file of information--a database, which can be so large that the processing and retrieval of information are practically impossible without computers. (The technical aspect proper of the communication system lies outside this work, but it is necessary to emphasize that the similarity of the means of communication, which are used by science and a number of other fields of activity, confirms the existence of a profound unity among the different spheres of human labor and cognition.)

In the modern history of scientific communication many new communication forms have been discovered and many old ones have been improved. The functioning of information and documentation services both on the organizational and on the purely technical and printing levels has been improved. This process is continuing intensively. In the middle of the 19th century regular scientific congresses (as a sporadic form of the contact of scientists, congresses, including international ones, also occurred even in the "prejournal period") became an essential innovation in the area of scientific communication, which proved to be fruitful for the further development of science. The appearance within the general system of scientific communication and information science of a special subsystem of "secondary information" was a no less important innovation, which underwent mass development in the 20th century. In the same way as congresses, "secondary information" had its own predecessors at an earlier stage, when, however, its forms (reviews, bibliographic references, and so on) were not perceived as a unified whole. The later (no earlier than the middle of the 20th century) appearance of the very term "secondary information," by which the services of review, survey, and current awareness information are understood, also indirectly points to this. The activity of these services is especially important for the assurance of efficiency and the continuous tracking of new knowledge. "Secondary information," like the equipment of communication, is one of the most important means of overcoming the negative things which are connected, on the one hand, with the "information explosion" and, on the other, with linguistic barriers (according to the data of UNESCO, about half of the scientific and scientific and technical literature is published in languages, of which less than half of all the specialists in the corresponding research fields have a command).

The progressive differentiation in science is creating the danger of the dissociation of the efforts of researchers. The differentiation of science, however, is eliminated dialectically in the processes of the establishment of broad and deeply penetrating relations among different fields of knowledge. On the content level the interpenetration and integration of scientific knowledge are the common basis for these processes (which are most pronounced precisely at the present stage of scientific progress). Accordingly, the

"intermediate" structural formations, which lead to the forming of new theoretical, as well as applied scientific, research fields, specialties, and occupations, are acquiring particular importance at the stage of the scientific and technical revolution.

We had to place the word "intermediate" in quotation marks, because many of these specialties, having originated as marginal fields, have received the status of "classical" fields and even are themselves involved in the devising of new related areas of research. Thus, ecology, which emerged at the juncture of the geography of plants and animals, evolutionary theory, and a number of applied disciplines (forest science, grassland science, and so on), has developed into a factor of the formation of an entire "cluster" of sciences--ecological chemistry, space ecology, or biocybernetics (in the sections of it, which study the equilibrium or dynamics of ecosystems). This example is also typical in the respect that it demonstrates the role of the demands of practice and applied knowledge in the emergence of interdisciplinary research: it is possible to get the most revealing examples of the emergence of such research precisely in the development of fields which are directly connected with practice. An interdisciplinary nature is especially characteristic of comprehensive (including simultaneously both theoretical support and the applied section) projects, moreover, precisely such projects were also the first model of interdisciplinary research in the history of science. The plan of the State Commission for the Electrification of Russia, which was drafted in 1920 on the instructions of V.I. Lenin, can serve as an example.

In a certain sense almost any study contains the multidisciplinary feature, even if it fits within a strictly defined research field, since science is a unified whole and each such field is linked by numerous ties with others. In the narrower and more common sense the research, which is performed at the juncture of two or more existing disciplines, is grouped with interdisciplinary research. At times interdisciplinary research and multidisciplinary research are differentiated, by grouping with the latter the research, within which individual components of the fields have not been fused into a new field of study, but are united only by the sphere of their application. However, these two cases cannot be compared, because many intermediate forms exist; moreover, in a number of cases multidisciplinary research appeared only as a phase of the emergence of interdisciplinary research.

The analysis of the quotations of publications made it possible to establish the structurization of the basic interdisciplinary research field in the sense of the existence of works of a different level of importance and a different rate of obsolescence, on the level of the branching of the system of influences in the given field, in the breakdown of works by countries, the number of authors, and so on. As a result it was found that the interdisciplinary nature of research tends to stimulate the international nature of works in the corresponding field, as well as that the interdisciplinary character itself of research (regardless of special budgetary expenditures) is conducive to the increase of scientific productivity in this field.

Within multidisciplinary research in a number of classifications "multidisciplinary" and "plurodisciplinary" research are distinguished. The studies, which in this context do not have internal interrelations (for example, at the same institute studies on mathematics, ethnography, chemical technology, and so on can be conducted simultaneously and be financed jointly--such instances are especially frequent in case of the establishment of new institutes or a university in centers, which do not have a strong scientific tradition), are grouped with the former; the studies being conducted simultaneously within one center in the area of sciences which are close to each other (for example, zoology, botany, and microbiology) are grouped with the latter. Both these cases (for example, in the classification of J. Berger) are contrasted with: on the one hand, interdisciplinary research proper, characteristic of which is close contact between the representatives of a number of sciences during the fulfillment of a common research program (for example, the study of the kinetics of chemical technological processes by mathematical methods or the establishment of a group for the cybernetic simulation of the harm done by agricultural pests, of which enthomologists, agronomists, and mathematicians will be members); on the other, "transdisciplinary" research, when a new base (for example, a methods base) is developed for several disciplines. In addition "superdisciplinary" fields of research, which include a compact group of disciplines (for example, physics as the aggregate of elementary particle physics, solid-state physics, optics, electrodynamics, acoustics, and other disciplines), are also distinguished. (Footnote 5) (See J. Berger, "Opinions and Facts," "Interdisciplinarites: Problems of Teaching and Research in Universities," Paris, 1972, pp 23-75) It is hardly possible to regard this approach to the analysis of interdisciplinary research as fruitful, since here excessive emphasis is placed on classification subtleties, while the real differences are much more flexible and unstable.

For the science of science interdisciplinary research is of considerable interest both on the theoretical level (since it acts as a nonstandard object which makes it possible to reveal new trends and regularities of the development of science) and on the practical level, since the management of interdisciplinary research in several respects differs from the management of traditional monodisciplinary work. In particular, during an interdisciplinary study the task of the establishment of contacts between the representatives of different specialties, as well as the use of the "multivariate" planning of research with the enlistment, for example, of the methods of factor analysis, arises. The rapid increase of the share of interdisciplinary research at the present stage points to the changed structure of the entire front of scientific knowledge. No longer the "discipline," which is relatively independent of other sciences, or "the field of knowledge," but the multidimensional research field, which reacts flexible to the multilevel needs of the national economy, acts as its basic nucleus. It takes the form of a comprehensive project, an interdisciplinary program, or, in general, some specific interdisciplinary section, in which a breakthrough not only to new knowledge of the object, but also to a new structure of the very front of research is accomplished.

The role of interdisciplinary research in the structure of modern scientific activity has especially increased since the beginning of the present

scientific and technical revolution. Now interdisciplinary research as a flexible and practically oriented type of scientific activity has acquired an adequate operational institutional base in the form of new forms of the organization of science—scientific centers, comprehensive programs, projects, and so on. The cooperation of representatives of different directions within practically any of the current multidimensional research programs, including space programs, geological programs, oceanographic programs, and so on, can serve as examples of vast complexes of interdisciplinary research. At the same time the process of the emergence of interdisciplinary complexes on the basis of individual disciplines is continuing. There is characteristic as a whole of the period of the scientific and technical revolution the transition from monodisciplinary to interdisciplinary research fields, which was predicted and substantiated by Academician V. Vernadskiy and is connected with the fact that "the increase of scientific knowledge of the 20th century is quickly erasing the boundaries between individual sciences. We are specializing more and more not in sciences, but in problems. This makes it possible, on the one hand, to become excessively absorbed in the phenomenon being studied and, on the other, to expand its coverage from all points of view." (Footnote 6) (V.I. Vernadskiy, "Razmyshleniya naturalista" [The Reflections of a Naturalist], Book 2, Moscow, 1977, p 54)

The increasing multidisciplinary nature of research fields along the entire front of modern science is conducive to the convergence of basic and applied research. The development of space research, within which such multidisciplinary fields as space biology and medicine, space geodesy, space gas dynamics, and so on have succeeded in being formed, can serve as a vivid example of the formation of a broad basic-applied complex of interdisciplinary research fields.

The growing interdisciplinary nature of science is making new demands on the organization and planning of research: interdisciplinary centers of science, both permanent ones (regional scientific centers, which unite a number of fields and organize their interaction) and temporary (specific research programs) or periodic ones (for example, the programs of the International Geophysical Year), are playing a greater and greater role. New demands are also arising in the area of the training of personnel: more and more attention, especially in the context of the problems of the long-range planning of science, is being given to the training of specialists in interdisciplinary fields. The activity of scientific centers of the higher school is also being organized accordingly. In particular, increased attention to consolidated projects of an interdisciplinary nature, for which these centers serve as the main organizations, is characteristic of the development of many regional scientific and educational centers in the USSR and other CEMA countries.

It should be noted that interdisciplinary research for all its importance at the present stage of the development of science by not means can replace or supersede monodisciplinary research. As to the relationship between interdisciplinary and monodisciplinary research, it is becoming to a greater and greater extent a relationship of mutual complementing, moreover, in many cases each of these two basic (on the level determined by the nature of the research field) categories of scientific research directly presumes the

existence of the other as its prerequisite. Such a relationship contributes to the functioning of scientific research and scientific activity as an open system, which is much more effective in the practical sense and adequately reflects the diverse objects, processes, and phenomena of surrounding reality.

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OVCHINNIKOV ON 27TH CPSU CONGRESS, TASKS OF SOVIET SCIENCE

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 10, Oct 86 pp 63-69

[Abridged version of report of Academician Yu.A. Ovchinnikov at the Festive Meeting devoted to the Day of Soviet Science, under the rubric "The Organization and Efficiency of Scientific Research": "The 27th CPSU Congress and the Tasks of Soviet Science"]

[Text] This year we are marking the Day of Soviet Science at a remarkable time, when all the Soviet people and all progressive mankind are dwelling in the spirit of the just concluded 27th Communist Party Congress, when intense and inspired work on implementing its decisions is being launched throughout the country. One of the key places within the program of our country's rapid social and economic development, which was set for by the congress, is assigned to science.

We, the workers of science, are proud of such a role and attention and at the same time realize the great responsibility and the need for the mobilization of the entire creative potential for the accomplishment of the posed tasks--today our thoughts and concerns are about this.

Today we are living a robust, intense existence. The country is solving the difficult problems of sharply increasing the efficiency of physical production and improving the well-being of the Soviet people, and is opposing and rebuffing the dark forces of imperialism and reaction. Together with the entire people the workers of science are seeking the best ways to accomplish the posed tasks, are searching out unused reserves, are criticizing and giving support to those who are not keeping up, and are emulating the leaders. History has not allowed Soviet scientists that many peaceful moments. But even in the worrisome days of "hot" and "cold" war, of adversity and trial, together with our allies and friends we created and consolidated the majestic edifice of Soviet science.

In the shortest, previously unprecedented time we established one of the best mathematical schools in the world and achieved acknowledged heights in such most important directions of physics as solid state physics and quantum electronics, elementary particle physics and astrophysics. We learned to build the best airplanes on earth, forced the entire world to listen excitedly to the signals of the first sputnik, and 25 years ago sent a simple, noble-

spirited Soviet youth for the first time into the distant reaches of space. We were the first to embark on the path of peaceful use of the atom and to discover chain reactions in chemistry, and today with a sense of enormous satisfaction we honor Academician N.N. Semenov and his outstanding school. Better than anyone in the world, we have learned to make metals and to obtain alloys with astonishing qualities.

Our science has supplied the country with all kinds of minerals, has penetrated deeper than all others into the bowels of the earth, and has presented the world with the noblest idea of the importance of the biosphere. Soviet scientists created the first doctrine concerning the origin of life, achieved great successes in the study of photosynthesis and higher nervous activity, and was able to attain leading levels in new areas of biology and biotechnology. In our country, the motherland of Leninism, the most important works of social thought were written, their revolutionary essence and effectiveness have been confirmed by the experience of building the first socialist state. We are known throughout the world for our works on history, archaeology, and literary criticism. For the first time in the history of human society we have solved the national question in science--large scientific complexes in Siberia and in the once distant periphery of our country and a branched network of republic academies have been created. In the USSR a generation of scientists, which was taught and inspired by the deeds and thoughts of N.I. Vavilov, V.I. Vernadskiy, A.F. Ioffe, I.V. Kurchatov, S.P. Korolev, A.N. Nesmeyanov, and M.V. Keldysh, scientists who were devoted to the end to the Communist Party and to the Soviet people, is serving the people.

But life demands new tempos, new decisions, new bright ideas and their realization. When the rhythm of development speeds up, imperfections and flaws are perceived more sharply throughout the national mechanism of Soviet science.

Concerned about effectiveness, we cannot reconcile ourselves to the fact that good ideas for a long time, sometimes a criminally long time, are not implemented and that we are lacking in the persistence and in the ability to change this situation. Specialists in the field of economics should deal more boldly with this sphere, just as all areas of the improvement of the economic mechanism, giving assistance to naturalists. In our science today the strategic task is to obtain the best original solutions and, without delay, to put them to use in the country's national economy. And our primary task, as the 27th congress specified, should be the development of the priority directions of scientific and technical progress in such scientific fields as power engineering, machine building, electronics, industrial chemistry, and biotechnology, as well as the solution of the problems of food resources, the efficient utilization of the environment, and human health protection. Precisely in this area science should demonstrate its ability to make a worthwhile contribution to strengthening our economic might and defense capabilities and to improving the well-being of Soviet people.

It is not difficult to understand the immensity of these problems and their political and historical significance for the country and for the entire cause of progress on earth. We must quickly eliminate the lag which has been noted

in certain areas, particularly in the practical implementation of scientific achievements, and show that the most progressive social system is also the most effective one in the improvement of social production. And if such a task has always faced us in general form, then the 27th party congress gave it a specific, significant form and placed it on a practical track.

In considering this responsible period, we clearly understand that these problems will not be solved without radical changes. A reform in the world outlook, in assessment of the quality of our scientific work is necessary; much self-criticism and strictness regarding our own achievements, as well as great demandingness on students and the maximum mobilization of their scientific potential are needed. A constant search for objective, and not subjective criteria for evaluating the level of what has been carried out or achieved is needed, it is necessary to eliminate the influence of vanity, cheap advertisement, or simply of insufficient competence on such an evaluation. A great deal depends upon the moral stance of the best representatives of our science and our academic guard, and more precisely, upon their stance and specific actions. The assurance of a truly world level of developments is the first, the most important condition for scientific and technical progress.

The structure of institutes and laboratories--these "living cells" of science--requires continuous improvement. The new wage system should offer new possibilities in this area, but we are slow and indecisive in introducing it, citing the complexity of this process, long-standing traditions, and human problems. We must more boldly promote and support within collectives and atmosphere of constant renewal and persistent searching.

It is necessary to place in greater earnest on the agenda the question of personnel training and retraining. The role of the individual in science will never be lost and the quality of the work of scientists has perhaps even greater significance here than in production. It is necessary to train enthusiastic people, who are dedicated to the cause of science, believe in its ideals, and possess high professionalism. How great is the value of a well-trained young specialist in theoretical physics, in fine organic synthesis, in genetic engineering, and in other areas of science! And how difficult it is to find ways to train him. We have so far done little to improve the process of training young scientists within higher educational institutions, are not making full use of their scientific potential, and are not adequately strengthening the ties between VUZ, academic, and sectorial science. A number of most important decisions have been made recently, but how difficult a path we have to travel before their speedy realization. And many unresolved questions still remain. Programs at higher educational institutions far from always correspond to the new directions of science and to the pressing areas of scientific and technical progress. At times the quality of textbooks is unsatisfactory, and there is a shortage of equipment and reagents.

It is necessary to strengthen consistently, not in words but in deed, the base of basic science. Many institutes of the USSR Academy of Sciences, the All-Union Academy of Agricultural Sciences imeni V.I. Lenin, and the USSR Academy of Medical Sciences and chairs of leading universities, which to a large extent determine the pace of development of basic fields of science, lack

adequately equipped facilities even in Moscow and Leningrad, where our basic scientific potential is concentrated. This reduces labor productivity, prolongs the time of scientific developments, and complicates the problem of personnel training. The construction base is weak in both the Academy of Sciences and the USSR Ministry of Higher and Secondary Specialized Education, while USSR Gosplan and other departments are failing to give them the proper support. Solution of this urgent national problem is directly tied to accelerating scientific and technical progress in our country.

We should not lose sight of prospects for developing large specialized scientific centers, such as Troitsk, Noginsk, Pushchino, and Dubna near Moscow, and should continue to establish similar complexes in other regions of the country. The laboratory base, housing, everyday living conditions, leisure, and health care facilities—we should keep everything in our field of view, so that young people will seek to go to these centers. It goes without saying that a true scientist is also prepared to work creatively while sitting on the edge of a stool, but you will not solve in this way present problems of scientific and technical progress. It is necessary to persistently continue to strengthen our scientific front in Siberia, in the Urals, and in the Far East, and not allow the potential of such centers to decline or be weakened.

We are constantly looking for new forms of the organization of science and means to strengthen the creative ties between our institutes and higher educational institutions, are improving the relations between science and production, are establishing scientific production associations, pilot works and sections, educational scientific centers, and base chairs, are concluding contracts on creative collaboration, and so forth.

This is far from a complete list of what we already have, and the search for the most effective forms constantly goes on. Today 18 interbranch scientific technical complexes in the most important directions of science, such as the Reliability, Catalyst, Personal Computer, and Biogen complexes, has been established. These complexes are growing stronger and we can count on them as the advance posts of scientific and technical progress. However, inertia and the underestimation of the necessary pace of work are frequently being maintained when setting up such complexes. The USSR State Committee for Science and Technology, USSR Gosplan, and the USSR Academy of Sciences must find an immediate solution to the problems of developing these new formations.

It is necessary to constantly strengthen international scientific relations. Our special concern is the Comprehensive Program of Scientific and Technical Progress of the CEMA Member Countries to 2000 and the fraternal consolidation of our common forces in order to solve pressing scientific and technical problems. The benefits here are mutual and indisputable, but the relations need to be made lively, permanent, and effective. It is necessary to raise the level of mutual information, to eliminate excessive bureaucracy in drawing up of documents for trips, and to be constantly sensitive to one another's needs, and then it will become possible to solve the most complex scientific and technical problems.

Several words about problems of modern scientific information. As is known, in science, both ours and foreign, the number of new publications, journals,

books, and data banks is growing like an avalanche. It is necessary to get our bearings in this sea of information, because this will reduce the time of scientific research and will raise the level of experiments. Many institutes, particularly in outlying areas, do not have the needed assortment of journals and books and are poorly supplied with copying equipment, the collections of many libraries, including central libraries, are inadequate. Computer technology is being introduced too slowly in this area. Incidentally, academicians, no less than school children, have a need for personal computers. However, the USSR Gosplan and other departments are dragging their feet and are not helping to change the situation that has developed.

I will briefly dwell on certain pressing problems of individual directions of scientific and technical progress.

The Basic Directions of USSR Economic and Social Development call for the fundamental restructuring and leading development of the machine building complex, first of all of machine tool building, instrument making, and the electrical equipment and electronics industry. Development of these sectors is of decisive significance for accelerating scientific and technical progress as a whole. However, it can be ensured only by broad utilization of the latest achievements of science.

The USSR Academy of Sciences can give vital assistance in the accomplishment of this task. The research being conducted by academic scientific institutions in the area of machine building is aimed at the development of machines and mechanisms for various purposes and methods of developing flexible machine systems and robotics, automatic control systems, and computer-aided design systems, at the development of means of reducing friction losses, and at the increase of the reliability and durability of machine building products.

The decisions of the 27th party congress call for the rapid development of computer technology. It is planned to increase its production volume by 2- to 2.5-fold; the mass production of personal computers should be organized. In this connection it is necessary to intensify the research at scientific institutions on problems of computer equipment, computational mathematics and information science, and the component base.

Microelectronics, quantum electronics and optics, which have become the main sources for creating many principally new types of equipment and technology, should be the most important directions of the technical sciences.

Elementary particle and nuclear physics continue to be the most important section of basic science. During the past 2 decades a deeper understanding of the microstructure of matter, the structure of elementary particles, and the nature of their interactions has been achieved. The continued development of research into elementary particles and atomic nuclei will doubtlessly deepen our knowledge of the structure of matter and will open new possibilities in science and technology.

It is known that theoretical research in this area is conducive to the development of nuclear power and frequently lead to important practical

results: it is enough to recall so-called nuclear filters and activation analysis. Research on the problem of controlled thermonuclear fusion will continue. Experiments in recent years at the largest installations (of the Tokamak type) in our country and abroad have shown that it is possible to obtain in them hot plasma with thermonuclear parameters. At the large installations of the next generation, which have been put into commission in recent times, scientists hope to complete the stage of purely physical research and to obtain full information on the physics of plasma with thermonuclear parameters, which is sufficient to move on to the creation of an experimental thermonuclear reactor.

Responsible tasks have been posed for the fuel and power complex. It is planned to meet the country's need for all types of fuel and power both by increasing their extraction and generation and by pursuing a purposeful energy-saving policy. Renewable, nontraditional sources of energy should be used more extensively, nuclear power will be rapidly developed.

One of the high-priority directions of scientific and technical progress is new materials and the technology of obtaining and processing them. In this connection research will continue on problems of solid state physics for the purpose of developing new construction and other materials, including technically valuable crystals. The results of research in the area of condensed state physics at low temperatures and high pressures and under the conditions of strong electrical and magnetic fields in the future will also be a most important source of practical applications.

Chemical science is making an important contribution to the development of construction and other materials for machine building sectors and the electronics and radio industries. During the upcoming period it is planned to launch work on creating new types of industrial ceramics and various composites and polymers.

The production of many most valuable preparations for medicine and agriculture is lagging behind the country's requirements. This situation should be corrected in the shortest possible time.

Important tasks have been set in the area of developing the mineral raw material base. To fulfill them it will be necessary to further develop research on the structure and evolution of the earth's crust and the world ocean. The work aimed at improving the methods of searching and prospecting for minerals will be intensified. Much attention will be devoted to the development of new technologies for extracting and processing mineral raw materials, which ensure a substantial increase in the completeness of the extraction of useful components, as well as the recovery mining waste products at the lowest cost. The development of new methods and equipment for the more complete extraction of hydrocarbon raw material from the earth remains an important problem.

Biologists together with specialists from other fields of science should focus their efforts on the solution of the food problem. New hardy strains of plants and breeds of animals, inexpensive feed protein, the rapid introduction of the achievements of genetic and cell engineering into practice--these today

are the primary tasks of the scientists at the USSR Academy of Sciences and the Academy of Agricultural Sciences imeni V.I. Lenin.

It is necessary to raise the level of ecological research. Ecology is a complex biological discipline, but we still are not devoting sufficient attention to it, placing the emphasis only on nature conservation measures. It is necessary to speed up the adoption of a unified ecological program for the country.

More attention should be given to medicine and medical science. Man, his health and how he feels should always remain at the center of attention. Unfortunately, the scientific and material base of medical research lags substantially, particularly in outlying regions. The system of test of medicinal preparations is very inert, in connection with which we simply do not have enough of many of the newest preparations. The need has arisen to make decisions on changing the situation that has developed, this concerns both science and the base of the medical and microbiological industry. Our country should not give up leadership in such an important sphere.

It is also necessary to speak about the social sciences, which include questions of our world outlook, culture, and economics; in them, as if under a magnifying glass, everything connected with the progress of knowledge is concentrated. We have no small number of unresolved problems here, and this is particularly true of the economists. More attention should be paid to the philosophical interpretation of the newest directions of science and technology, a barrier against speculative judgments and unjustified sensationalism should be erected. It is necessary to correctly evaluate new currents and to perceive their meaning in time. A healthy, working atmosphere and clear tasks exist in our science today, and this helps to better solve the great problems of the present time.

In conclusion I want to emphasize that it is necessary to improve the organization of Soviet science, to attach to its development true, and not verbal, priority.

Unity, solidarity, better organization and discipline, the concentration of efforts on important gains, economic knowledge, political maturity--this is what we need both today and in the future. The homeland awaits new accomplishments from scientists, and we are obligated to justify there hopes.

The questions are frequently asked: What can be expected from science now, on the threshold of the third millennium? If war is eliminated on earth, if the forces of peace and progress come out on top, and we will always struggle for this, then the task of eliminating unproductive manual labor from our lives, of creating inexhaustible and inexpensive sources of energy, of encompassing the globe with a unified system of transportation, communications, and computers, of developing in practice the depths of the ocean and the expanses of space, of eliminating once and for all the problem of harmful industrial wastes, of understanding the causes of man's most dangerous diseases, and of finding means of combating them seems achievable. Without a doubt, one of the main contributions will be made by the scientists of the Soviet Union and the countries of the socialist community.

We support the peace-loving policy of our country and the proposals and actions of the Soviet leadership and condemn aggressors and political adventurers. In our creative work we are promoting the highest ideals of humanism, cooperation, and peace.

Soviet scientists have been and will always remain faithful to the cause of Leninism and will work selflessly to implement the majestic plans of the party and the people in the name of the triumph of peace and progress.

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